

3 1761 11555994 0

CAI FR 11
47C12

CANADA,
DEPARTMENT OF MINES AND RESOURCES
LANDS, PARKS AND FORESTS BRANCH
DOMINION FOREST SERVICE

CANADA'S FORESTS AND THE WAR

(Report prepared for the Fifth British Empire Forestry Conference
to be held in the United Kingdom, 1947.)



OTTAWA
EDMOND CLOUTIER, C.M.G., B.A., L.Ph.,
KING'S PRINTER AND CONTROLLER OF STATIONERY
1947



FOREWORD

This report is written in conformity with the official outline for The British Empire Forestry Conference, 1947, meeting in the United Kingdom. Quantities and values, however, are expressed in Canadian units in order to allow general distribution in Canada.

Converting factors used to express Canadian commercial units in terms of cubic volume of roundwood, without bark, appear in Table 6 of the report.

Annual figures in all tables are computed on a calendar year basis.

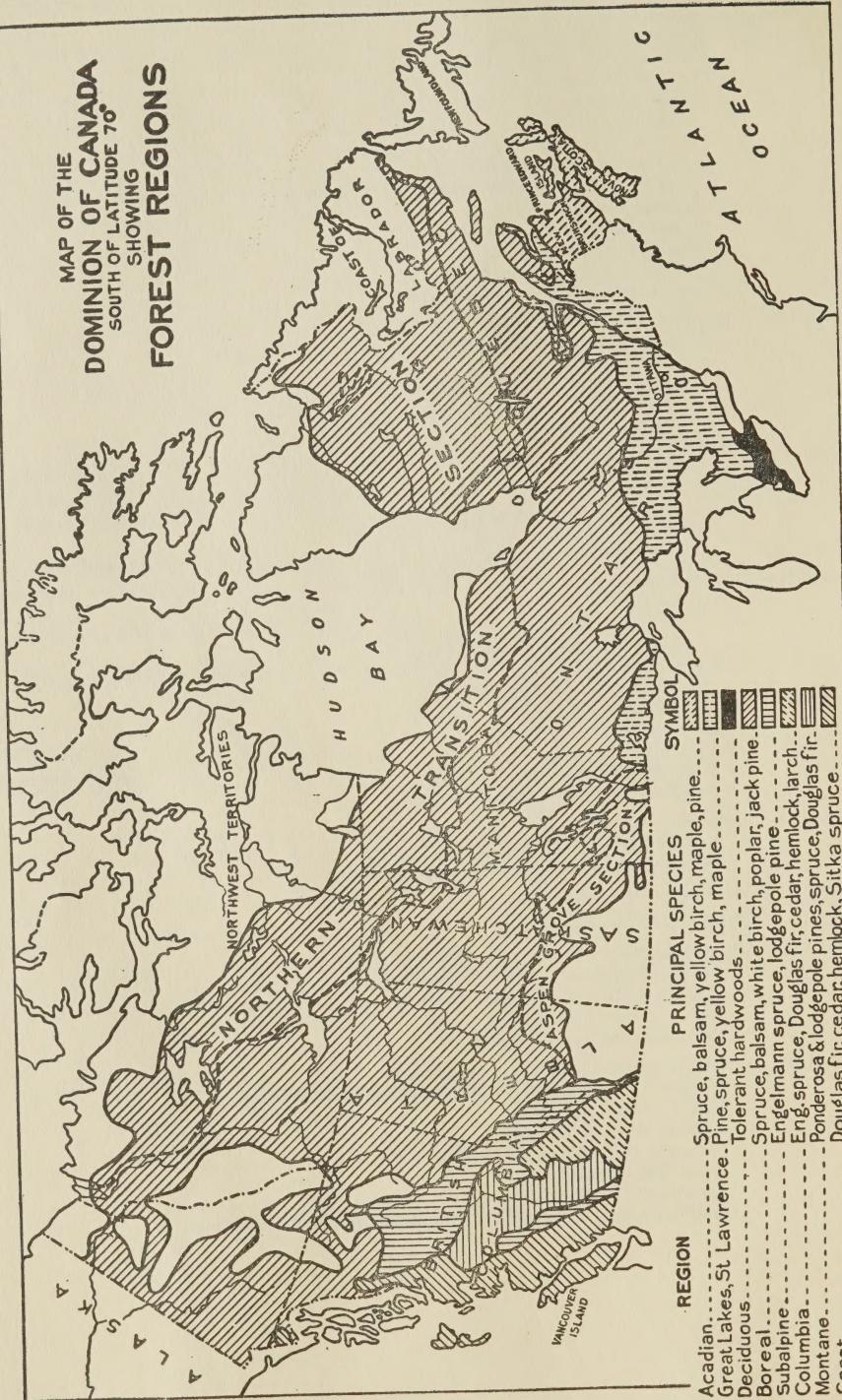
Export and import figures for the United States, throughout this report, include Alaska.

OTTAWA,
November, 1946.

CONTENTS

	PAGE
CHAPTER I— Forestry in the Pre-war Economy of Canada.....	5
Forest Regions.....	5
Principal Tree Species.....	6
Forest Areas.....	6
Ownership of Forest Lands.....	8
Volume of Merchantable Timber.....	8
Drain and Increment.....	9
Forest Industries.....	11
Logging.....	12
Sawmill Industry.....	12
Pulp and Paper Industry.....	13
Fuel-wood and Miscellaneous Primary Products.....	13
External Trade.....	15
Transportation.....	15
Minor Forest Products.....	15
Employment and Consumption.....	16
Pre-war Forest Policy and Management.....	16
CHAPTER II— The Effect of the War on Timber Supplies.....	19
Domestic Demand for Forest Products.....	19
Lumber.....	19
Pulpwood, Wood Pulp, and Paper.....	20
Fuel-wood.....	21
Special Products.....	21
Export Demand.....	22
Log Exports.....	22
Pulpwood Exports.....	22
Other Roundwood Exports.....	22
Lumber Exports.....	23
Pulp and Paper Exports.....	23
CHAPTER III— Wartime Controls.....	25
Timber Control.....	25
Control of Prices.....	26
Administration of Pulp and Paper.....	27
Special Agencies.....	27
Aero Timber Products, Ltd.....	27
Veneer Log Supply, Ltd.....	27
Development of Resources.....	27
Economy in Use.....	28
Working of New Forests.....	28
New Uses and Substitutions of Timber.....	29
CHAPTER IV— Manpower.....	31
Use of Forest Service Personnel.....	31
Manpower in Forest Industries during the War.....	31
CHAPTER V— Canadian Forestry Corps.....	35
CHAPTER VI— Effects of the War on Forestry.....	39
CHAPTER VII— Effects of the War on Future Forest Policy.....	41
Probable Permanency of War Developments.....	41
Use of New Timbers and Other Products.....	41
New Structural Uses of Wood.....	42
Effects on Silvicultural Practice.....	44
CHAPTER VIII— Wartime Lessons and Their Future Application.....	45
Wartime Role of the Forestry Profession and Forest Services.....	45
Role of Trade Organizations.....	45
Reserves of Forest Products.....	46
Correction of Wartime Deficiencies.....	46
Forest Rehabilitation.....	46
Research and Education.....	48
Possible Changes in Forest Policy and Administrative Organization.....	50

MAP OF THE
DOMINION OF CANADA
SOUTH OF LATITUDE 70°
SHOWING
FOREST REGIONS



REGION	PRINCIPAL SPECIES	SYMBOL
Acadian	Spruce, balsam, yellow birch, maple, pine.	.....
Great Lakes, St. Lawrence	Pine, spruce, yellow birch, maple.	.....
Deciduous	Tolerant hardwoods.	- - - - -
Boreal	Spruce, balsam, white birch, poplar, jack pine.	.....
Subalpine	Engelmann spruce, larch, hemlock, jack pine.	.....
Columbian	Eng. spruce, Douglas fir, cedar, hemlock, arch.	.....
Montane	Ponderosa & lodgepole pines, spruce, Douglas fir.	.....
Coast	Douglas fir, cedar, hemlock, Sitka spruce.	.....

CANADA'S FORESTS AND THE WAR

CHAPTER I

Forestry in the Pre-War Economy of Canada

Prior to the outbreak of war in 1939, forests and forest industries had attained great importance in the economic structure of Canada. Among the countries of the world, Canada stood in first place as an exporter of forest products and ranked third as a producer. Although her forests had been exploited for more than 150 years, she was in a position to increase her output when the urgent needs of war arose. This chapter reviews the forest situation as it existed during the five-year period 1934-38, in order to provide a background against which descriptions of subsequent events during the war may be brought into perspective.

Broadly speaking, Canada is divided into two parts by the sixtieth parallel of north latitude. All lands lying to the north of this parallel, except a relatively small portion of the Ungava peninsula in the Province of Quebec, are comprised within the Northwest and Yukon Territories and are administered by the Dominion Government. These territories, totalling 1,511,979 square miles in area, are sparsely forested towards the south and west but devoid of tree growth in the northern and eastern portions. Such forests as exist are of great value to the small local populations, and particularly to the rapidly developing mining industry of the region, but they offer few if any possibilities for ordinary commercial development.

The area south of latitude 60° N., totalling 2,178,431 square miles, is divided among the nine provinces of Canada. Each province administers its own natural resources, excepting only the National Parks, Forest Experiment Stations, Indian Reserves, and a few small parcels of Ordnance and other lands which are controlled by the Dominion. The Dominion does, however, assist in the development of provincial natural resources and the industries based on them by maintaining mapping and research organizations, of which the Dominion Forest Service is one.

Nearly three-fifths of the combined land area of the nine provinces is forested, while only 14 per cent lies in occupied farms. Since conditions of soil and climate suitable for agriculture are found, for the most part, in the more southerly portions of the Dominion, most of the population is distributed in a long narrow belt, bounded on the south by the International Boundary between Canada and the United States and extending from the Atlantic Ocean to the Pacific. The population of the Maritime Provinces and the southwest of British Columbia is well distributed within important forest regions, but in most other parts of the Dominion population and industry are concentrated in the south, while the great forest areas lie to the northward. In consequence, large areas of productive forest land are located at great distances from centres of manufacture and consumption, and the proper protection and development of these forests present problems of very considerable difficulty.

FOREST REGIONS

Canada's forests may be divided on an ecological basis into eight regions*, each of which is characterized by the dominance of certain tree species and forest types. Boundaries and principal species of these regions are indicated by the accompanying map, although many details are omitted because of the smallness of the scale. Differences in the forests of these regions are caused by varying climate, geology, topography, and soils, of which the most important factor is climate. Each region may be further subdivided into sections on the basis of minor differences in forest conditions.

The map shows clearly that the Boreal Forest Region covers a far larger area than the other seven regions combined. Two sections of the Boreal forest are shown on the map because of their special characteristics—one along the northern margin, and the other bordering the open prairies. The Northern Transition Section is an area of scattered and stunted tree growth which cannot be expected to produce merchantable timber because of the extreme rigour of the climate. The Aspen-Grove Section is a zone of transition between true forest and the semi-arid grasslands.

The relative importance of the principal forest regions, based on gross areas, is shown in the following table:

Region	Per Cent of Total Forest Formations
Boreal Forest.....	81.0
Great Lakes-St. Lawrence.....	7.0
Sub-alpine.....	4.0
Coast.....	2.4
Montane.....	2.4
Acadian.....	2.0
Columbia.....	0.8
Deciduous.....	0.4
	100.0

* For more detailed discussion of forest regions see Dominion Forest Service Bulletin 89, "A Forest Classification for Canada", by W. E. D. Halliday.

The importance of the Coast Forest Region is much greater than its small area might suggest, because of the size and kinds of timber it contains and the rapid growth of its forests.

PRINCIPAL TREE SPECIES

The common and botanical names of the more important tree species of Canada are listed hereunder. Practically speaking, the species classified as "Western" are restricted to the Province of British Columbia, although some of them do occur on the eastern slopes of the Rocky Mountains in Alberta. White spruce, here classified as "Eastern", is also widely distributed in the northern interior of British Columbia.

	Eastern Species		Hardwoods
Softwoods			
White spruce— <i>Picea glauca</i>		Aspen— <i>Populus tremuloides</i>	
Black spruce— <i>Picea mariana</i>		Large-toothed aspen— <i>Populus grandidentata</i>	
Red spruce— <i>Picea rubra</i>		Balsam poplar— <i>Populus tacamahaca</i>	
Eastern white pine— <i>Pinus Strobus</i>		Yellow birch— <i>Betula lutea</i>	
Red pine— <i>Pinus resinosa</i>		White birch— <i>Betula papyrifera</i>	
Jack pine— <i>Pinus Banksiana</i>		Sugar maple— <i>Acer saccharum</i>	
Eastern hemlock— <i>Tsuga canadensis</i>		Red maple— <i>Acer rubrum</i>	
Eastern white cedar— <i>Thuja occidentalis</i>		White elm— <i>Ulmus americana</i>	
Balsam fir— <i>Abies balsamea</i>		Rock elm— <i>Ulmus Thomasii</i>	
Tamarack— <i>Larix laricina</i>		Basswood— <i>Tilia glabra</i>	
		White ash— <i>Fraxinus americana</i>	
		Black ash— <i>Fraxinus nigra</i>	
		Beech— <i>Fagus grandifolia</i>	
		White oak— <i>Quercus alba</i>	
		Red oak— <i>Quercus borealis</i>	
	Western Species		
Douglas fir— <i>Pseudotsuga taxifolia</i>		Black cottonwood— <i>Populus trichocarpa</i>	
Western hemlock— <i>Tsuga heterophylla</i>		Western white birch— <i>Betula papyrifera</i>	
Western red cedar— <i>Thuja plicata</i>		var. <i>occidentalis</i>	
Yellow cedar— <i>Chamaecyparis nootkatensis</i>		Red alder— <i>Alnus rubra</i>	
Western white pine— <i>Pinus monticola</i>		Broad-leaved maple— <i>Acer macrophyllum</i>	
Ponderosa pine— <i>Pinus ponderosa</i>			
Lodgepole pine— <i>Pinus contorta</i> var. <i>latifolia</i>			
Sitka spruce— <i>Picea sitchensis</i>			
Engelmann spruce— <i>Picea Engelmannii</i>			
Grand fir— <i>Abies grandis</i>			
Amabilis fir— <i>Abies amabilis</i>			
Alpine fir— <i>Abies lasiocarpa</i>			
Western larch— <i>Larix occidentalis</i>			

FOREST AREAS

The total forested area of Canada is estimated to be 1,290,960 square miles. Forests occupy 38 per cent of the total land area of the Dominion and 58 per cent of the land area of the nine provinces.

There were 11.2 million people resident in Canada in 1938. Population per square mile of land area was 3.3 for the Dominion as a whole, and 5.6 for the provincial area. Forest area per capita was 74.2 acres, of which 46.6 acres were classed as productive forest land.

About one-third of the total forest area is believed to be incapable of producing crops of merchantable timber because of adverse site conditions. Such "unproductive" forests are valuable because they protect drainage basins, shelter game and fur-bearing animals, and are sources of fuel-wood for travellers, but they are of little significance to forest industry.

The "productive" forested area is estimated to be 813,110 square miles, of which some 435,000 square miles are now classified as accessible to commercial operators. The remainder constitutes a reserve for the future which will be developed as transportation systems are extended, but the presently inaccessible forests will be found, on the average, to be less productive than those now being worked. The relative importance of the main forest types in the accessible productive area is as follows:

	Forest Type	Per Cent
Softwoods.....		47
Mixedwoods.....		35
Hardwoods.....		18
		<hr/>
		100

About one-half of the accessible forest area is occupied by trees now large enough to be used for pulpwood or saw timber, and the remainder by younger stands which will eventually grow to merchantable dimensions. Much of the forest classed as "merchantable" is relatively young and is growing rapidly. Although it is not yet possible to classify the whole forest by age-classes, the over-all situation in this respect is believed to be fairly good. In some of the most easily accessible localities, however, age-class distribution is very poor because of too intensive utilization and repeated forest fires.

CANADA'S FORESTS AND THE WAR

TABLE 1—LAND CLASSIFICATION—SQUARE MILES

Province or Territory	Forested Land						Non-forested Land			Total Area	
	Productive Forested Land			Total Productive All Types			Non-productive Forested Land				
	Softwood	Mixedwood	Hardwood	Merchantable	Young Growth	Merchantable	Young Growth	Total	Land	Water	Total
Prince Edward Island.....	90	215	150	130	15	10	265	355	610	1,574	2,134
Nova Scotia.....	4,600	3,180	820	480	1,620	850	7,040	4,510	11,550	9,143	20,743
New Brunswick.....	5,000	3,000	7,000	5,000	1,000	1,000	13,000	9,000	22,000	190	5,283
Quebec.....	202,080	46,270	24,880	20,840	2,880	5,750	229,840	72,860	302,700	69,590	151,570
Ontario.....	36,900	29,300	24,100	67,400	5,900	10,200	66,900	106,900	173,800	63,400	126,082
Totals, Eastern Provinces.....	248,670	81,965	56,950	93,850	11,445	17,810	317,035	193,625	510,660	133,230	293,652
Manitoba.....	1,830	9,110	1,100	5,120	1,680	11,600	4,610	25,830	30,440	62,500	126,783
Saskatchewan.....	1,500	6,420	2,000	9,390	2,860	23,890	6,360	39,700	46,060	40,000	151,915
Alberta.....	7,700	24,070	9,360	31,430	3,620	16,880	20,680	72,380	93,060	37,560	118,180
Totals, Prairie Provinces.....	11,030	39,600	12,460	45,940	8,160	52,370	31,650	137,910	169,560	140,060	396,878
British Columbia.....	35,400	50,490	.....	.....	.....	.....	35,400	50,490	85,890	128,560	144,829
Totals, All Provinces.....	295,100	172,055	69,410	139,790	19,575	70,180	384,085	382,025	766,110	401,850	835,359
Northwest Territories and Yukon.....	4,200	22,800	1,000	5,000	2,800	11,200	8,000	47,000	76,000	1,340,563	1,458,784
GRAND TOTAL, CANADA.....	299,300	194,855	70,410	144,790	22,375	81,380	392,085	421,025	813,110	477,850	2,175,922
Percentages of Net Land.....	8.6	%	%	%	4.2	0.7	%	%	12.1	%	100.0

The importance of the Coast Forest Region is much greater than its small area might suggest, because of the size and kinds of timber it contains and the rapid growth of its forests.

PRINCIPAL TREE SPECIES

The common and botanical names of the more important tree species of Canada are listed hereunder. Practically speaking, the species classified as "Western" are restricted to the Province of British Columbia, although some of them do occur on the eastern slopes of the Rocky Mountains in Alberta. White spruce, here classified as "Eastern", is also widely distributed in the northern interior of British Columbia.

Eastern Species		Western Species	
Softwoods	Hardwoods	Softwoods	Hardwoods
White spruce— <i>Picea glauca</i>	Aspen— <i>Populus tremuloides</i>	Douglas fir— <i>Pseudotsuga taxifolia</i>	Black cottonwood— <i>Populus trichocarpa</i>
Black spruce— <i>Picea mariana</i>	Large-toothed aspen— <i>Populus grandidentata</i>	Western hemlock— <i>Tsuga heterophylla</i>	Western white birch— <i>Betula papyrifera</i>
Red spruce— <i>Picea rubra</i>	Balsam poplar— <i>Populus tacamahaca</i>	Western red cedar— <i>Thuja plicata</i>	var. <i>occidentalis</i>
Eastern white pine— <i>Pinus strobus</i>	Yellow birch— <i>Betula lutea</i>	Yellow cedar— <i>Chamaecyparis nootkatensis</i>	Red alder— <i>Alnus rubra</i>
Red pine— <i>Pinus resinosa</i>	White birch— <i>Betula papyrifera</i>	Western white pine— <i>Pinus monticola</i>	Broad-leaved maple— <i>Acer macrophyllum</i>
Jack pine— <i>Pinus banksiana</i>	Sugar maple— <i>Acer saccharum</i>	Ponderosa pine— <i>Pinus ponderosa</i>	
Eastern hemlock— <i>Tsuga canadensis</i>	Red maple— <i>Acer rubrum</i>	Lodgepole pine— <i>Pinus contorta</i> var.	
Eastern white cedar— <i>Thuja occidentalis</i>	White elm— <i>Ulmus americana</i>	<i>latifolia</i>	
Balsam fir— <i>Abies balsamea</i>	Rock elm— <i>Ulmus thomasii</i>	Sitka spruce— <i>Picea sitchensis</i>	
Tamarack— <i>Larix laricina</i>	Basswood— <i>Tilia glabra</i>	Engelmann spruce— <i>Picea engelmannii</i>	
	White ash— <i>Fraxinus americana</i>	Grand fir— <i>Abies grandis</i>	
	Black ash— <i>Fraxinus nigra</i>	Amabilis fir— <i>Abies amabilis</i>	
	Beech— <i>Fagus grandifolia</i>	Alpine fir— <i>Abies lasiocarpa</i>	
	White oak— <i>Quercus alba</i>	Western larch— <i>Larix occidentalis</i>	
	Red oak— <i>Quercus borealis</i>		

FOREST AREAS

The total forested area of Canada is estimated to be 1,290,960 square miles. Forests occupy 38 per cent of the total land area of the Dominion and 58 per cent of the land area of the nine provinces.

There were 11.2 million people resident in Canada in 1938. Population per square mile of land area was 3.3 for the Dominion as a whole, and 5.6 for the provincial area. Forest area per capita was 74.2 acres, of which 46.6 acres were classed as productive forest land.

About one-third of the total forest area is believed to be incapable of producing crops of merchantable timber because of adverse site conditions. Such "unproductive" forests are valuable because they protect drainage basins, shelter game and fur-bearing animals, and are sources of fuel-wood for travellers, but they are of little significance to forest industry.

The "productive" forested area is estimated to be 813,110 square miles, of which some 435,000 square miles are now classified as accessible to commercial operators. The remainder constitutes a reserve for the future which will be developed as transportation systems are extended, but the presently inaccessible forests will be found, on the average, to be less productive than those now being worked. The relative importance of the main forest types in the accessible productive area is as follows:—

	Forest Type	Per Cent
Softwoods.....		47
Mixedwoods.....		35
Hardwoods.....		18
		<hr/> 100

About one-half of the accessible forest area is occupied by trees now large enough to be used for pulpwood or saw timber, and the remainder by younger stands which will eventually grow to merchantable dimensions. Much of the forest classed as "merchantable" is relatively young and is growing rapidly. Although it is not yet possible to classify the whole forest by age-classes, the over-all situation in this respect is believed to be fairly good. In some of the most easily accessible localities, however, age-class distribution is very poor because of too intensive utilization and repeated forest fires.

TABLE 1—LAND CLASSIFICATION—SQUARE MILES

Province or Territory	Forested Land						Non-forested Land			Total Area	
	Productive Forested Land			Non-productive Forested Land							
	Softwood Merchantable	Mixedwood Merchantable	Hardwood Young Growth	Merchantable	Young Growth	Total Productive All Types	Land	Water	Total		
Prince Edward Island.....	90	215	150	130	15	10	255	355	610	2,184	
Nova Scotia.....	4,600	3,180	820	480	1,420	850	7,040	4,510	11,550	9,143	
New Brunswick.....	5,000	3,000	7,000	5,000	1,000	1,000	13,000	9,000	22,000	190	
Quebec.....	202,080	46,270	24,880	20,840	2,880	5,750	229,840	72,860	302,700	69,590	
Ontario.....	36,900	29,300	24,100	67,400	5,900	10,200	66,900	106,900	173,800	63,400	
Totals, Eastern Provinces.....	248,670	81,965	56,950	93,850	11,415	17,810	317,035	193,625	510,660	133,230	
Manitoba.....	1,830	9,110	1,100	5,120	1,880	11,600	4,610	25,830	30,440	62,500	
Saskatchewan.....	1,500	6,420	2,000	9,390	2,860	23,890	6,380	39,700	46,060	40,000	
Alberta.....	7,700	24,070	9,360	31,430	3,620	16,880	20,680	72,380	93,060	37,580	
Totals, Prairie Provinces.....	11,030	39,600	12,460	45,940	8,160	52,370	31,650	137,910	169,560	140,060	
British Columbia.....	35,400	50,490	.....	.....	.....	35,400	50,490	85,890	128,560	144,329
Totals, All Provinces.....	295,100	172,055	69,410	139,790	19,575	70,180	384,085	382,025	766,110	401,850	
Northwest Territories and Yukon.....	4,200	22,800	1,000	5,000	2,800	11,200	8,000	39,000	47,000	76,000	
GRAND TOTAL, CANADA.....	299,300	194,855	70,410	144,790	22,375	81,380	392,085	421,025	813,110	477,850	
Percentages of Net Land.....	8.6%	5.6%	2.0%	4.2%	0.7%	2.3%	11.3%	12.1%	13.8%	62.8%	
							%	%	%	100.0	

OWNERSHIP OF FOREST LANDS

Ownership of more than 90 per cent of the total forest area of Canada is still vested in the Crown. An exception to the general rule is found in the Maritime Provinces where all the forests in Prince Edward Island, 71 per cent of the forests of Nova Scotia, and 50 per cent of the forests of New Brunswick are privately owned.

Although it is the fixed policy of all the provincial governments to retain title to their Crown forests, none of them engage directly in logging operations. Private operators are granted rights to cut timber on Crown lands through a system of leases and annual licences which is sufficiently flexible to provide for the needs of operations differing widely in character and extent. Some of the larger areas are granted for long periods of time, subject to the fulfilment of certain basic requirements laid down by the governments concerned. Forest areas set aside for the maintenance of the great pulp and paper mills are leased in this way. At the other extreme, rights to cut small quantities of wood may be granted to individuals by way of short-term timber sales, good for from one to five years only. In all cases operators are required to pay Crown dues assessed on each unit of wood as cutting proceeds. In addition, they are usually required to pay annual rentals for the land occupied, and fire protection taxes. The distribution of occupied Crown lands and privately-owned lands, by provinces, appears in Table 2.

TABLE 2—OWNERSHIP OF OCCUPIED FOREST LANDS, 1944

Square Miles

Province	Occupied Crown Lands					Private Lands		
	Pulp and Paper Licences	Saw Timber Licences	Timber Sales	Permit Berths	Total	Held by Corporations and Individuals	Farm Woodlots	Total
Prince Edward Island.....	721		68		789	115	493	608
Nova Scotia.....	4,000	6,500			10,500	4,979	3,241	8,220
New Brunswick.....	65,245	10,110			75,355	7,555	3,445	11,000
Quebec.....	55,717	973	12,248		68,938	16,920	9,710	26,630
Ontario.....	2,754	357	191	29	3,331	8,211	6,029	14,240
Manitoba.....						9,440	2,390	11,830
Saskatchewan.....		336	154		540	6,250	4,007	10,257
Alberta.....		482	52	245	779	5,749	4,255	10,004
British Columbia.....	752	3,172	513	681	5,118	5,820	1,566	7,386
CANADA.....	129,189	21,980	13,226	955	165,350	65,039	35,136	100,175

Total Area—Occupied Forest Lands—265,525 square miles.

Most accessible of all the forests of Canada are the so-called farm woodlots—small wooded tracts, usually forming parts of the farms of their owners. Woodlots range in size from 3 or 4 acres to 200 acres or more. In Eastern Canada these woodlots, taken as a group, are highly productive because they lie in the southern part of the country, many of them occupying soils of considerably higher quality than those typical of the more extensive forests of the north. It is now known that the retention of a sufficient percentage of farming areas under tree cover is the best method of preventing erosion and maintaining the ground water table at a satisfactory level. It is considered that from 15 to 20 per cent of predominantly farming districts should remain under timber to ensure stable soil conditions and water supplies. On the open prairies of the West it is not possible to establish farm forests approximating the above-mentioned percentages of total area, but much progress has been made in planting shelterbelts around farm buildings and for the protection of field crops. The relative importance of the farm woodlot in British Columbia, predominantly a forest province, is less than in other parts of the Dominion.

It is noteworthy that about 30 per cent of all wood cut in Canada comes from the relatively small area of farm woodlots. Most of this volume is in the form of fuel-wood, for use on the farm and for sale, but the woodlots contribute about 1,000,000 cords of pulpwood annually to the pulp and paper industry and also provide substantial quantities of sawlogs and other products.

VOLUME OF MERCHANTABLE TIMBER

The volume of merchantable standing timber in Canada is estimated to be 311,201 million cubic feet. This cubic volume does not include wood contained in stumps or unusable tops of trees, which would be left on the ground after logging. Nearly 62 per cent of the total volume is considered to be accessible. Estimates of volumes in cubic feet, by species, appear in Table 3, and estimates of accessible volumes are expressed in commercial units of measurement in Table 4.

In the preparation of Table 3, estimates originally expressed in commercial units were converted to equivalent volumes in cubic feet through use of the factors shown in Table 6.

TABLE 3—VOLUMES OF MERCHANTABLE TIMBER, BY SPECIES
Millions of Cubic Feet

Species	Accessible	Inaccessible	Total
Spruce.....	61,145	43,733	104,928
Balsam fir.....	23,505	22,162	45,667
Douglas fir.....	5,256	5,708	10,964
Hemlock.....	5,628	6,902	12,530
White Pine.....	2,991	140	3,131
Red Pine.....	810	.....	810
Jack and lodgepole pines.....	26,209	23,156	49,365
Ponderosa pine.....	411	307	718
Cedar.....	5,868	4,797	10,665
Larch.....	622	278	900
Yellow Cedar.....	267	298	565
Total Conifers.....	132,712	107,531	240,243
Poplar.....	23,201	8,262	31,463
White Birch.....	18,498	4,061	22,559
Yellow Birch.....	6,375	.....	6,375
Maple.....	6,654	.....	6,654
Beech.....	1,845	.....	1,845
Elm.....	837	.....	837
Ash.....	487	.....	487
Basswood.....	467	.....	467
Oak.....	103	.....	103
Other Hardwoods.....	168	.....	168
Total Hardwoods.....	58,635	12,323	70,958
TOTALS, ALL SPECIES.....	191,347	119,854	311,201

NOTE.—Volumes do not include wood in stumps and tops.

DRAIN AND INCREMENT

In many countries in Europe practically all the forests are managed in accordance with carefully prepared working plans, and the large and varied demand for forest products makes possible the utilization of nearly all the wood produced. Young trees which would otherwise succumb to competition are removed in the course of thinnings and put to use, and the final crops are harvested at maturity. Under such circumstances it is not difficult to estimate average annual growth, and to compare the figure so computed with estimates of volumes of wood removed from the forest for use or destroyed by fires or forest pests. If the "growth-drain ratio" shows that utilization and losses are about equal to growth, the forest manager may conclude that conditions are satisfactory, or if drain exceeds growth he may feel that restriction of use and further reduction of losses must be made effective to prevent deterioration of the forest. Thus the "growth-drain ratio" has a positive meaning and there is a direct and obvious connection between the ideas of growth and yield.

Under conditions now existing in Canada, no such simple comparison of growth and yield and drain is possible for the country as a whole. Because population is small in comparison with forest area, because that population is not well distributed in relation to the forests, and because many regions are not yet served by permanent transportation facilities, much of the forest area of Canada is not being used at all. Annual growth in the inaccessible regions undoubtedly aggregates a very large volume of wood, but this growth is offset in its entirety by natural mortality. In future, when forests now inaccessible are opened up, the productive power of their soils will be put to use and trees which formerly would have decayed will be used. For the present, however, growth in inaccessible areas does not help to replace losses occurring elsewhere. Hence annual growth in these unused forests has no immediate significance in the national wood balance sheet.

Even for the areas classed as commercially accessible no simple and direct answer can be given to the question: How does annual growth compare with annual drain? There are many degrees of accessibility and there is a natural tendency to confine logging operations to the areas most easily reached. In times of stress this tendency is greatly intensified. For example, during the war it was necessary to obtain maximum output from a restricted labour force, and time and energy could not be spared for opening up new areas; if economic depression occurs, the effort to minimize costs has a similar result. In Canada, the distribution of the population greatly accentuates the difficulties of working the forest estate as a whole. As a result of these conditions, there are many localities which have been logged over too heavily and too often, with consequent deterioration of the forest, many other areas which, even though classed as accessible, have been cut over only at long intervals, and still others which have not been touched at all. To the damage caused by too intensive utilization of the most easily reached forests must be added relatively heavy fire losses.

TABLE 4—ACCESSIBLE TIMBER OF MERCHANTABLE SIZE

Province	SAW TIMBER Millions of Feet Board Measure						SMALLER MATERIAL Thousands of Cords							
	Douglas Fir	Spruce and Balsam Fir	Hemlock	White and Red Pine	Jack and Lodgepole Pine	Cedar	Other Soft-woods	Hardwoods	Total	Spruce and Balsam Fir	Jack and Lodgepole Pine	Poplar	All Other Species	Total
Prince Edward Island.....	65	.....	.....	.....	.....	.....	.....	40	105	560	.....	5	235	800
Nova Scotia.....	3,505	685	660	.....	.....	.....	1,600	6,450	22,345	25	840	5,805	29,105	
New Brunswick.....	4,000	200	600	300	800	100	3,000	9,000	46,000	2,000	4,500	27,500	80,000	
Quebec.....	37,160	70	1,420	1,825	610	25	14,390	55,500	395,745	39,600	21,185	172,920	629,450	
Ontario.....	23,900	795	5,885	11,945	65	.....	11,390	53,950	205,800	55,715	116,380	182,035	559,930	
Total, Eastern Provinces.....	68,630	1,750	8,565	14,040	1,475	125	30,420	125,005	670,450	97,340	142,910	388,585	1,299,285	
Manitoba.....	785	.....	70	.....	.....	.....	1,620	2,475	6,510	3,065	18,300	880	28,755	
Saskatchewan.....	1,470	.....	380	.....	.....	.....	2,100	3,950	6,450	2,270	50,000	1,260	59,380	
Alberta.....	100	5,190	.....	1,700	.....	10	2,080	9,080	19,100	55,000	35,000	1,300	110,400	
Total, Prairie Provinces.....	100	7,445	.....	2,130	.....	10	5,800	15,505	32,060	60,335	103,300	3,440	199,135	
British Columbia—Coast.....	16,615	14,600	22,695	275	35	20,490	1,400	.....	76,110	2,580	10	.....	11,335	13,925
British Columbia—Interior.....	7,260	13,685	2,290	580	2,635	4,105	3,075	.....	33,630	49,635	106,290	.....	16,540	172,365
Total, British Columbia.....	23,875	28,285	24,985	855	2,670	24,595	4,475	.....	109,740	52,115	106,300	.....	27,875	186,290
Total, All Provinces.....	23,975	104,360	26,735	9,420	18,860	26,070	4,610	36,220	250,250	754,625	283,975	246,210	419,900	1,684,710

The average annual drain from 1934 to 1938 was nearly 3,000 million cubic feet. Details appear in the following table:—

AVERAGE ANNUAL DRAIN, 1934-1938

Quantities	Equivalent Volumes	Percentage of Total
	M. Cu. Ft.	
Utilized—		
Logs and bolts 3,837,814 M ft. b.m.	717,517	23.9
Pulpwood 6,695,191 cords	571,328	19.1
Fuel-wood 8,869,094 cords	709,527	23.7
Other primary products.....	85,196	2.8
Sub-total.....	2,083,568	69.5
Destroyed—		
By forest fires.....	414,386	13.8
By insects and disease.....	500,000	16.7
Sub-total.....	914,386	30.5
Total annual drain.....	2,997,954	100.0

It can be shown that replacement of annual drain requires an average rate of growth of only 11 to 12 cubic feet of merchantable wood per acre over the whole area of accessible productive forest. Replacement of coniferous species alone requires average growth of about 14 cubic feet on each accessible acre where these species now grow. Since it is known that much higher rates of growth are obtained over a wide range of conditions in northern Europe, and since natural reproduction of one kind or another follows logging fairly quickly in most parts of Canada, it is probable that drain is being replaced by growth so far as total volume of all species is concerned.

The kind of new forest being established is another matter, because many former coniferous stands are replaced, at least temporarily, by less valuable deciduous species. These in turn may gradually give way to coniferous or mixed forests, but the process may be slow.

Many field studies of actual rates of growth in different forest types have been made, and increments of 40, 60 and even 90 cubic feet per acre have been recorded, but a vast amount of work remains to be done before any precise statement of Canada's growth-drain ratio can be made. On the facts now available, it seems certain that Canada is potentially capable of supporting far larger forest industries than she now has; but it is equally certain that any radical expansion of industry without the introduction of much improved forest management would be detrimental.

FOREST INDUSTRIES

The three primary forest industries of Canada are woods operations (or logging), sawmilling, and the manufacture of pulp and paper. In addition to these main industries, there are large and important groups of secondary industries which use partially manufactured wood, pulp, or paper as their principal raw materials.

Some of the principal statistics relating to the primary and secondary forest industries in 1938 are shown in the following table:—

SUMMARY OF STATISTICS OF FOREST INDUSTRIES, 1938

Industry	Capital Invested	Employees	Salaries and Wages	Gross Value of Products
	\$	No.	\$	\$
Woods operations.....	185,000,000	71,000 ¹	74,000,000	148,265,857
Sawmills.....	88,812,313	31,182	25,345,064	92,855,906
Pulp and paper mills.....	594,908,222	30,943	42,619,311	183,897,503
Wood-using industries.....	95,697,442	30,597	26,984,592	80,397,651
Paper-using industries ²	53,197,243	11,665	13,234,150	58,179,241
Total.....	1,017,615,220	175,387	182,183,117	563,596,158

¹ Man-year basis.² Exclusive of the printing trades.

Since the products of one branch of industry may be used as raw materials by another, the summation of the gross or sale value of the products of all the industries contains duplications of values. In order to determine the contribution of the forest industries as a group to the national output of wealth, it is necessary to arrive at the net value of production of each of them by subtracting from gross value the cost of materials and supplies used and the cost of purchased power. Total net value of production of the forest industries in 1938 amounted to nearly \$311,000,000. This figure may be compared with the estimated gross national product (income of individuals,

TABLE 5—OUTPUT OF HOME-GROWN WOOD

Thousands of Cubic Feet

Period (1)	Timber (2)	Roundwood (3)	Pulpwood (4)	Fuel-wood (5)	Charcoal and Distillation Wood (6)	Total (7)	Value \$ (8)
Average, 1934-38—							
(i) Softwoods.....	669,952	80,814	554,086	106,429	.....	1,411,281	.....
(ii) Hardwoods.....	47,565	.....	17,242	603,098	4,332	672,287	.....
Total.....	717,517	80,814	571,328	709,527	4,332	2,083,568	133,464,297
1939—							
(i) Softwoods.....	800,221	88,526	568,289	109,354	.....	1,566,390	.....
(ii) Hardwoods.....	49,955	.....	18,210	619,672	4,356	692,193	.....
Total.....	850,176	88,526	586,499	729,026	4,356	2,258,583	157,747,398
1940—							
(i) Softwoods.....	1,037,852	112,711	702,622	110,067	.....	1,963,252	.....
(ii) Hardwoods.....	64,360	.....	19,871	623,715	5,616	713,562	.....
Total.....	1,102,212	112,711	722,493	733,782	5,616	2,676,814	194,567,875
1941—							
(i) Softwoods.....	1,018,989	89,290	780,298	103,345	.....	1,991,922	.....
(ii) Hardwoods.....	69,039	.....	31,001	585,618	6,151	691,809	.....
Total.....	1,088,028	89,290	811,299	688,963	6,151	2,683,731	213,163,089
1942—							
(i) Softwoods.....	931,564	66,097	789,042	104,647	.....	1,891,350	.....
(ii) Hardwoods.....	84,871	.....	31,512	592,999	7,873	717,255	.....
Total.....	1,016,435	66,097	820,554	697,646	7,873	2,608,605	234,371,891
1943—							
(i) Softwoods.....	836,507	68,759	717,813	110,524	.....	1,733,103	.....
(ii) Hardwoods.....	78,786	.....	30,803	628,304	6,910	742,803	.....
Total.....	915,293	68,759	748,116	736,828	6,910	2,475,906	268,615,233
1944—							
(i) Softwoods.....	882,561	79,010	700,965	107,018	.....	1,769,554	.....
(ii) Hardwoods.....	88,832	.....	35,863	606,437	7,360	733,492	.....
Total.....	971,393	79,010	736,828	713,455	7,360	2,508,046	301,570,823

plus depreciation charges, plus international balances on dividend and interest accounts) of \$5,226,000,000. Approximately 6 per cent of the national product was derived from forestry and forest industries. In 1943 both the national product and the net value of production of the forest and wood-using industries were approximately double the above figures.

Logging

In Eastern Canada most sawmilling companies conduct their own logging operations, and pulp and paper mills obtain a large proportion of their requirements from their own camps. There are, however, many independent pulpwood loggers who sell their output to the pulp companies or on the export market. On the coast of British Columbia there is an important independent logging industry, some units of which conduct logging operations on a very large scale. This industry has been extended in recent years by a large number of relatively small companies which specialize in truck logging (as distinct from railroad operations). About 40 per cent of the coast output is produced by independent loggers who sell to the so-called "log-buying" sawmills and for export. The remainder is produced by companies which own and supply their own sawmills.

The output of logs, pulpwood, fuel-wood, and other primary forest products, before the war and during war years, is shown in Table 5.

Sawmill Industry

The sawmill industry is the most widely distributed of all Canadian manufacturing industries. It is made up of 44 mills, each producing more than 15,000,000 ft. b.m. of lumber annually, 89 producing from 5,000,000 to 15,000,000 feet, 665 producing 1,000,000 to 5,000,000 feet, and over 4,000 small mills whose average production is less than 1,000,000 feet annually. About 30 of the largest mills are located on the west coast of British Columbia and this small region normally produces about one-half of all the lumber cut in Canada. Except on the west coast, where operations are continuous throughout the year, sawmilling is a seasonal business. Most large mills do their sawing during the summer and early autumn, though there are a few mills of fair

size which saw during the winter. All the smaller mills work on a seasonal basis, but different units may operate at different times of the year. Many of the smallest portable mills are owned and operated by farmers and their sawing season is dictated in part by the exigencies of other farm work. It has been estimated that the small number of large mills produce about 34 per cent of the annual cut, the intermediate groups 43 per cent, and the multitude of small mills 23 per cent.

In the larger mills the headsaws are usually of the band type and these are often followed by band resaws. At the other extreme, the small portable mills almost invariably use rotary saws with inserted teeth which cut a rather wide kerf. A few log gang-saws are in operation, mainly on the west coast, and there appears to be a growing interest in the introduction of this type of machinery for cutting up small logs. Lumber produced in 1938 totalled 3,768,351 thousand feet board measure.

Pulp and Paper Industry

In 1938, Canada had 27 pulp mills, 48 combined pulp and paper mills, and 24 paper mills, a total of 99 units, in operation. Their output of wood pulp totalled 3,667,789 tons, of which 3,122,180 were used by the Canadian industry in the manufacture of paper. The most important product marketed by the industry was newsprint paper, of which 2,668,913 tons were produced in the year under review. All other papers totalled 580,445 tons.

Of all the pulp manufactured in Canada, more than 90 per cent was made from the wood of spruce and balsam fir. Considerable quantities of Western hemlock were used for pulp on the west coast, and in the East smaller quantities of jack pine, Eastern hemlock and poplar were used. Most large pulp and paper mills conducted operations on their own timber limits and also bought large quantities of wood from farmers and other outside sources. In 1938, about two-thirds of the pulpwood used by the Canadian industry came from its own limits and one-third was purchased.

The pulp and paper industry is exceptionally important in the Canadian economy because, in pre-war years, the value of exports of paper was greater than that of any other commodity. In 1938, it stood in first place among all Canadian manufacturing industries with respect to capital employed, salaries and wages paid, and net value of production. In number of employees and in gross value of production it stood second. This industry was the largest consumer of hydro-electric power in the country and, in a sense, made possible the expansion of hydro-electric power development that played so important a part during the war.

Fuel-wood and Miscellaneous Primary Products

Although almost one-third of all the wood consumed in Canada each year is burnt as fuel, there is no organized fuel-wood industry. More than 85 per cent of the total amount used is produced by farmers, either from their own woodlots or from nearby public lands. Two-thirds of the quantity cut is consumed on the farms, and the remainder is sold in the cities and towns. There is practically no external trade in this commodity.

In the aggregate, the output of such miscellaneous primary products as telegraph and telephone poles, hewn railway ties, and fence-posts is of considerable value but, with the exception of hewn ties, most of this output comes from a multitude of small operations.

Table 6 shows the converting factors used to express Canadian commercial units in terms of cubic volume of roundwood, without bark.

In Tables 7, 8, 9 and 10 will be found statements showing the average production, exports, imports, and apparent home consumption of primary forest products, lumber, wood pulp, and paper during the period 1934-1938. These figures are shown in comparison with performance during the individual war years.

TABLE 6—FACTORS USED TO CONVERT CANADIAN COMMERCIAL UNITS TO CUBIC FEET
(Cubic Feet—the equivalent of round timber in true measure under bark)

Product	Canadian Commercial Unit	Volume of Roundwood Used
		Cubic feet
Logs and other sawn and hewn timber.....	1,000 ft. b.m.	200*
Lath.....	1,000 pieces	33
Pickets.....	1,000 pieces	266
Poles, hop poles, piling.....	1 piece	15
Fence-posts.....	1 piece	1.2
Railway ties.....	1 piece	5
Pulpwood, rough.....	1 cord	85
Pulpwood, peeled.....	1 cord	95
Fuel-wood.....	1 cord	80
Shingle bolts and lathwood.....	1 cord	85
Pit-props.....	1 cord	85
Shingles.....	1 square	20
Charcoal—kiln.....	1 ton	200
Charcoal—distillation.....	1 ton	152
Pulp, mechanical.....	1 ton	85
Pulp, chemical.....	1 ton	170
Newsprint.....	1 ton	95
Other paper.....	1 ton	170

* West coast—175 cu. ft.

TABLE 7—PRODUCTION, EXPORTS, IMPORTS, AND HOME CONSUMPTION OF ALL PRIMARY FOREST PRODUCTS¹

Quantities are expressed in thousands of cubic feet of roundwood

Period	Production		Exports		Imports		Home Consumption	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
	M. cu. ft.	\$000	M. cu. ft.	\$000	M. cu. ft.	\$000	M. cu. ft.	\$000
Average, 1934-38.....	2,083,568	133,464	189,292	15,462	8,573	686	1,902,849	118,688
1939.....	2,258,583	157,747	226,006	21,314	9,866	954	2,042,443	137,387
1940.....	2,676,814	194,568	226,223	24,607	13,602	1,429	2,464,193	171,390
1941.....	2,683,731	213,163	250,599	26,466	8,800	1,141	2,441,932	187,838
1942.....	2,608,605	234,372	228,226	28,586	10,963	1,232	2,391,342	207,018
1943.....	2,475,906	268,615	172,201	26,269	8,495	1,391	2,312,200	243,737
1944.....	2,508,046	301,571	186,590	32,725	10,701	1,885	2,332,157	270,731

¹ Includes all products in the state in which they were removed from the forest—logs, pulpwood, poles, hewn ties, fuel-wood, etc.

N.A.—Not available.

TABLE 8—LUMBER PRODUCTION, EXPORTS, IMPORTS, AND APPARENT CONSUMPTION
Quantities in Thousands of Feet Board Measure

Period	Production		Exports		Imports		Apparent Consumption	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
	M. ft. b.m.	\$000	M. ft. b.m.	\$000	M. ft. b.m.	\$000	M. ft. b.m.	\$000
Average, 1934-38.....	3,347,557	61,159	1,699,805	35,805	83,554	3,333	1,731,286	28,687
1939.....	3,976,882	78,332	2,211,933	50,548	77,041	3,392	1,841,990	31,176
1940.....	4,629,052	105,991	2,548,681	69,803	81,849	4,476	2,162,920	40,664
1941.....	4,941,054	129,288	2,300,875	74,813	60,024	4,002	2,700,233	58,477
1942.....	4,935,145	149,855	2,179,956	80,692	40,807	3,088	2,795,996	72,251
1943.....	4,363,575	151,900	1,741,276	74,739	34,308	2,981	2,656,607	80,142
1944.....	4,512,232	170,351	1,882,519	90,950	35,828	3,161	2,665,541	82,562
1945.....	4,900,000*	N.A.	2,001,042	99,995	51,315	4,203	2,950,273*	N.A.

* Preliminary.

N.A.—Not available.

TABLE 9—WOOD PULP PRODUCTION, EXPORTS, IMPORTS, AND APPARENT CONSUMPTION
Quantities in Tons (2,000 lb.)

Period	Production		Exports		Imports		Apparent Consumption	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
	Tons	\$000	Tons	\$000	Tons	\$000	Tons	\$000
Average, 1934-38.....	4,159,883	90,482	689,473	30,773	16,364	533	3,486,774	60,242
1939.....	4,166,301	97,132	705,516	31,001	21,544	763	3,482,329	66,894
1940.....	5,290,762	149,005	1,068,517	60,930	19,996	814	4,242,241	88,889
1941.....	5,720,847	175,440	1,411,724	85,898	20,653	1,070	4,329,776	90,612
1942.....	5,606,461	192,145	1,510,746	95,267	21,451	1,299	4,117,166	98,177
1943.....	5,272,830	194,519	1,556,456	100,013	21,662	1,452	3,738,036	95,958
1944.....	5,271,137	211,041	1,408,081	101,563	13,747	1,100	3,876,803	110,578
1945.....	5,600,814	231,873	1,434,526	106,055	14,510	1,166	4,180,798	126,984

TABLE 10—PAPER PRODUCTION, EXPORTS, IMPORTS, AND APPARENT CONSUMPTION
Quantities in Tons (2,000 lb.)

Period	Production		Exports		Imports		Apparent Consumption	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
	Tons	\$000	Tons	\$000	Tons	\$000	Tons	\$000
Average, 1934-38.....	3,550,368	144,107	2,841,547	108,315	49,737	6,708	758,558	42,500
1939.....	3,600,502	170,776	2,795,877	124,127	65,114	8,654	869,739	55,303
1940.....	4,319,414	225,837	3,489,945	170,880	55,349	8,858	884,818	63,815
1941.....	4,524,776	241,153	3,587,181	176,184	53,702	9,341	991,297	74,310
1942.....	4,231,767	230,270	3,241,941	157,838	80,510	10,675	1,070,336	83,107
1943.....	3,966,344	234,036	2,983,874	160,825	69,055	10,702	1,051,525	83,913
1944.....	4,044,376	255,546	3,012,973	177,290	66,297	12,157	1,097,700	90,413
1945.....	4,359,576	282,838	3,285,610	203,012	75,382	13,376	1,149,348	93,202

EXTERNAL TRADE

Investments of foreign capital in Canada are much larger than Canadian investments abroad, consequently the Canadian balance of international payments contains a large debit item on interest and dividend account, which amounted to \$241,000,000 in 1938. Other substantial debits arise from freight, shipping, and miscellaneous transactions. To offset these debits Canada depends on exports of non-monetary gold, the tourist traffic, and a favourable balance from commodity trade, of which the last mentioned is the most important. Forest industries play a part of exceptional significance in the establishment of a satisfactory commodity trade balance. From 45 to 55 per cent of the Canadian lumber output and more than 90 per cent of newsprint paper are normally exported. In addition, large quantities of pulpwood and other primary products are sold abroad. Imports of forest products, on the other hand, are relatively small, and in 1938 external trade in "wood, wood products, and paper" yielded a favourable balance of just under \$180,000,000. The importance of this contribution may be judged from the fact that the adjusted commodity merchandise trade balance, arising from all commodities including forest products, was \$195,000,000. During the war years, favourable balances from trade in wood, wood products and paper averaged about \$360,000,000.

TRANSPORTATION

Forest products provide an important volume of traffic for Canadian railways. In 1938 they accounted for 17 per cent of all car loadings in the Dominion. The following table shows the tonnages of the principal forest products hauled in that year:

Product	Railway Freight Loaded	
	Tons	Per Cent
Lumber.....	2,572,842	25.5
Pulpwood.....	2,728,551	27.1
Pulp and paper.....	2,464,685	24.4
Logs and other forest products.....	2,317,715	23.0
Total all forest products.....	10,083,793	100.0

Aside from traffic provided for common carriers, the logging industry utilizes a large amount of automotive transport in the movement of logs and supplies. For the most part this work is done by trucks owned by the operators themselves, but there are a few companies which specialize in contract hauling. Logging companies on the west coast have large investments in standard gauge railroads which are used exclusively for log transportation.

MINOR FOREST PRODUCTS

The production of maple syrup and sugar on farm woodlots in Ontario, Quebec, New Brunswick, and Nova Scotia constitutes a minor forest industry which had a pre-war production value of more than three million dollars annually. It has been estimated that from twenty to twenty-five million sugar maple trees tapped each spring during pre-war years yielded, in terms of maple syrup, an annual average of more than 2,600,000 gallons.

The Christmas tree industry is carried on mainly in the Maritime Provinces, Quebec, and British Columbia. The species used are balsam fir and spruce in the East, and Douglas fir in the West. It is estimated that almost six million of these trees are exported to the United States each year, in addition to an annual home consumption of about one million trees. The pre-war value of exports was almost \$400,000.

TABLE 11—MINOR FOREST PRODUCTS
Output, Imports, Exports, and Home Consumption

Category	AVERAGE FOR THE YEARS 1934 TO 1938				AVERAGE FOR THE YEARS 1939 TO 1945			
	Output Total Value	Imports C.I.F. Value	Exports F.O.B. Value	Home Consump- tion Value	Output Total Value	Imports C.I.F. Value	Exports F.O.B. Value	Home Consump- tion Value
	\$	\$	\$	\$	\$	\$	\$	\$
Bamboos, canes.....	45,917	.....	45,917	.....	56,310	.....	.....	56,310
Bark for Tanning.....	N.A.	10,266	4,507	N.A.	N.A.	13,303	3,610	N.A.
Christmas Trees.....	N.A.	.....	398,019	N.A.	N.A.	.....	852,625	N.A.
Cork and Cork Products.....	686,164	.....	686,164	.....	1,420,241	.....	.....	1,420,241
Gums and Resins.....	N.A.	1,218,465	13,190	N.A.	N.A.	2,143,594	35,239	N.A.
Maple Syrup and Sugar.....	3,274,340	771	843,948	2,431,163	5,319,042	1,860	1,466,536	3,854,366
Pine Tar.....	N.A.	44,610	.....	N.A.	N.A.	91,752	.....	N.A.
Turpentine.....	N.A.	359,692	2,312	N.A.	N.A.	919,249	5,965	N.A.
Wood Ashes.....	N.A.	.....	1,832	N.A.	N.A.	.....	775	N.A.
TOTAL.....	2,365,885	1,263,808	.....	.....	4,646,309	2,364,750	.....	.....

N.A.—Not available.

Spruce gum is an oleoresinous exudation obtained from red, black, and white spruce. Collection is most easily carried out in the late fall or winter when the gum can be chipped from the trees with a suitable tool. For market purposes two grades of gum are recognized, namely, "lump", which is used as gathered, and "chip", which is cleaned by steaming and straining. Canada balsam is an oleoresin obtained by puncturing the blisters found on the bark of balsam fir. It is a transparent, yellowish liquid of the consistency of honey.

The average annual pre-war value of imports of gums and resins was over \$1,200,000, while the value of exports exceeded \$13,000.

Volatile oils, called essential oils, are prepared from the leaves and twigs of certain coniferous species. The most important is cedar leaf oil, manufactured by the steam distillation process from Eastern white cedar. Small quantities of spruce, hemlock and pine oils are also produced.

With the exception of small quantities of turpentine, naval stores are not produced in Canada. This turpentine is obtained in the course of producing pulp from jack pine by the sulphate process, by passing the "blow-off" gases from the digesters through condensers. The crude turpentine thus obtained is further purified before marketing.

Table 11 gives available figures on output, exports, imports and home consumption of minor forest products for the pre-war years in comparison with the average for the war years.

EMPLOYMENT AND CONSUMPTION

Employment in woods operations east of the Rocky Mountains is almost entirely on a seasonal basis. Climatic conditions generally are such that the cutting and hauling of logs can be carried on most economically during the fall and winter months. In the coastal region of British Columbia the logging methods employed in the larger sized timber entail the use of cable systems and logging railways which are more or less independent of weather conditions, and as a result operations are carried on throughout the year. Pre-war employment in woods operations in Canada averaged 83,000 man-years, producing over 2,000 million cubic feet of wood annually.

The following table gives employment and production or utilization in the forest industries for the pre-war period of 1934 to 1938, in comparison with an average for the war years of 1939 to 1944.

EMPLOYMENT, PRODUCTION, AND UTILIZATION IN FOREST INDUSTRIES

ANNUAL AVERAGE—1934 TO 1938

	Industrial Units	Persons Employed ¹	Production or Utilization ²
	No.	No.	M. Cu. Ft.
Woods operations.....		83,000	2,083,568
Sawmills.....	3,723	38,438	745,414
Pulp and paper mills.....	96	29,691	456,976
Wood-using industries.....	2,024	28,586	N.A.
Paper-using industries ³	275	10,109	N.A.

ANNUAL AVERAGE—1939 TO 1944

Woods operations.....		103,707	2,535,280
Sawmills.....	10,352	40,873	1,024,567
Pulp and paper mills.....	104	35,963	597,535
Wood-using industries.....	2,016	41,165	N.A.
Paper-using industries ³	332	15,951	N.A.

¹ Man-year basis.

² Roundwood equivalents.

³ Excluding printing trades.

N.A.—Not available.

The lumber industry, which operates seasonally in Eastern Canada in much the same manner as woods operations, averaged over 3,700 sawmills in the pre-war years, employing 38,438 persons annually and processing over 745 million cubic feet of wood.

The pulp and paper industry, operating on a year-round basis, employed during the pre-war years almost 30,000 persons in 96 mills, and utilized about 457 million cubic feet of wood.

The products of sawmills and pulp and paper mills are used to a considerable extent as raw materials for the wood and paper-using industries. Previous to the war these industries employed about 39,000 men annually in 2,300 establishments.

Total employment in all primary and secondary forest industries averaged in the neighbourhood of 190,000 persons annually for the pre-war years. To these should be added practically every form of industrial activity, as very few industries are entirely independent of the use of wood, either directly or indirectly.

PRE-WAR FOREST POLICY AND MANAGEMENT

With the exception of forests in the Northwest and Yukon Territories, the National Parks, and a few smaller areas under the control of the Dominion Government, the Crown forests of Canada are administered by the governments of the individual provinces. In the older provinces—Ontario, Quebec, and the Maritime Provinces—the forests have always been entirely under the control of the provincial authorities. This is also true of British Columbia, although this province, on entering Confederation in 1871, ceded certain tracts of land to the Dominion Government; however, it retained the greater portion of its forested areas. In the case of the three provinces created subsequent to Confederation—Manitoba, Saskatchewan, and Alberta (the Prairie Provinces)—control of the forests was retained by the Dominion until, in 1930, full control of all natural resources was vested in the western provinces.

The Dominion Forest Service (formerly known as the Forestry Branch, Department of the Interior) is a part of the Lands, Parks and Forests Branch of the Department of Mines and Resources. It has no administrative jurisdiction over the forests generally (with the exception of certain experimental areas established on lands still under Dominion control) but is concerned solely with research and investigation in the fields of silviculture, protection, air and ground surveys, forest economics, and forest products.

Since each province is free to adopt whatever forestry laws and regulations may seem appropriate to the provincial legislature, it might be expected that very great differences between provincial policies would have developed. Some differences do exist, but the similarities in administration which are to be found from coast to coast are far more striking than the differences. Most important of these similarities is the retention of Crown forest lands in public ownership. This broad principle was developed in three provinces prior to Confederation (1867) and was adopted by the provinces created after that date.

Until the early years of the present century, the main object of all forest administrations was to dispose of rights to cut timber as rapidly as the forest industries required them, and to collect as much revenue from the forests as possible. In some regions the complete removal of timber stands was deliberately encouraged in order that lands might be cleared for agricultural settlement. Some rudimentary attempts to deal with forest fires were, in the main, feeble and ineffective.

In 1906, the first national conference on forestry was called in Ottawa by the Prime Minister of Canada, Sir Wilfrid Laurier, and this event may be considered as the turning-point in the development of forest policies throughout the Dominion. During the following decade separate forest authorities were established by a number of provincial governments, and fire protection services were re-organized and expanded. In some cases, however, timber revenues continued to be collected by one branch of the government service while responsibility for forest protection and the development of forest management rested with another.

The War of 1914-18 severely checked the growth of the embryo forest services but, by the time hostilities broke out again in 1939, a great deal of progress had been made. Full responsibility for administration of the forests, including the collection of revenues, had been centralized in the forest services; forest protection organizations had been greatly improved; and, in some provinces, the larger holders of cutting rights on Crown lands had been required by law to formulate systematic working plans and to submit them for the approval of government authorities.

In bygone years, rights to cut timber on specified areas of forest land, known as "timber limits", were disposed of without the guidance of any definite plan. Many sawmills were erected, of such large sizes and daily capacities that the timber tributary to their sites could not possibly supply them for more than a few years. As an inevitable aftermath came devastated forests and abandoned "ghost" towns. High prices and a buoyant demand for newsprint paper during the 1920s resulted in too rapid an expansion of the newsprint industry and culminated in financial disaster for many investors during the dark days of the early 1930s. The lessons of these misfortunes, however, have not been wasted, and to-day it is the settled policy of governments to permit expansion of industry only to the extent that sober analysis of market potentialities seems to justify, and to restrict the size of industries drawing upon the forests of a given region to the productive capacity of that region. As an example of the changed attitude, a recent Ontario law restricts the annual capacity of any new sawmill which may be erected in the province to 15 million board feet.

Development of rational forest policies has been greatly assisted by the extension of forest surveys and the compilation of more reliable forest inventories. These inventories are not yet fully satisfactory, but they have been vastly improved during the past quarter-century. The development of aerial survey methods, by which immense tracts of forest can be quickly and accurately described, has been of inestimable value to Canada. In particular, aerial methods have made it possible to define with reasonable accuracy the northern limits beyond which no further reserves of merchantable timber are to be found. Thus the old myth that new forests to replace those now being cut could always be found to the northward has finally been dispelled.

Among the practical problems of forest management in Canada, protection against forest fires takes first place. The existence of immense areas of unbroken coniferous forest and the difficulties of transportation combine to make fire protection a difficult and costly business but great progress has been made. Lookout towers keep the more accessible forests under constant observation, and aircraft patrol the more remote areas during the dangerous seasons. Radio and the telephone provide quick means of communication when fires are detected. Portable fire pumps, specially designed hose, and many other devices add greatly to the effectiveness of fire-fighting crews. But all these improvements taken together are not enough, and further great strides will be required before forest properties in Canada can be considered a sound insurable risk. In particular, there is great need for more intensive public education with respect to the dangers of forest fires and the need for caution in the woods.

Second only in importance to the fire hazard is the menace of epidemic outbreaks of injurious forest insects. Here again the very extent of the forests which may be affected poses special problems and presents special difficulties. No satisfactory means have yet been devised for checking major outbreaks of such pests as the spruce budworm, once they have got well under way, but it is hoped that they can be suppressed if they are attacked in the early stages. To

this end a forest insect survey is carried out each year through the co-operation of the Dominion and provincial governments and the larger industrial companies. At the same time, intensive study of major forest insects and possible methods for their control is carried on by the Forest Entomology Division of the Dominion Department of Agriculture, and by some of the provinces.

Except for research work, the practice of silviculture in the extensive forests of Canada has been pretty much restricted to requirements by some provincial governments that trees below certain specified diameter limits should not be cut, except under authority of special permits which may be issued where clear-cutting is obviously desirable. A limited amount of forest planting has been undertaken on lands where it has seemed hopeless to rely on natural regeneration. The total extent of plantations in Canada in 1939 was estimated to be about 175,000 acres, or about 273 square miles. The area of plantations more than 30 years old was very small.

The rudimentary stage of development of silvicultural practice may be ascribed to a number of causes, chief among which have been lack of appreciation for its need and lack of funds for its execution. While large areas of virgin forest, produced by nature without cost, are available to the logger, prices of standing timber inevitably remain low. Again, the depressed condition of markets during the last pre-war decade caused operators to work to a very small margin of profit, or even at a loss, without undertaking additional expenditures for silviculture. On the other hand, the fact that logs had to be transported over greater and greater distances, with consequent rising transportation costs, and improved knowledge of the limitations of the national forest resources, combined to focus attention on the possibilities of increasing yields from the more easily accessible forest lands through the introduction of silviculture.

An important feature of the development of forest policy in the inter-war period was the increasing amount of attention being given to research in forestry and in the utilization of forest products. The principal forest research organization in Canada is the Dominion Forest Service, which operates five Forest Experiment Stations and two Forest Products Laboratories, and also co-operates in the support of the Pulp and Paper Research Institute. In addition to silvicultural research, the Forest Service carries on research in problems connected with fire protection and conducts economic investigations. It has also taken a leading part in the development of methods for the use of aerial photographs for forest inventory purposes. Forest research work is also carried on by the Provinces of Quebec, Ontario and British Columbia.

CHAPTER II

The Effect of War on Timber Supplies

The average volume of primary forest products used annually during the five-year period 1934-38, and the volumes used in each of the years from 1939 to 1944, appear in Table 5. Canadian statistics do not show separately volumes from Crown lands and from privately owned lands. It is known, however, that about one-third of the total volume used annually for all purposes is taken from farm woodlots, largely in the form of fuel-wood.

Although the average rate of utilization was 22 per cent higher in the war years than in the period 1934-38, total drain of wood from the forests increased by only 10 per cent because average fire losses were lower than usual. This is particularly remarkable in view of the fact that fire losses reported in 1941 were the highest in 20 years.

Most of the timber felled on the west coast came from virgin forests of great age, but a large proportion of the wood used in Eastern Canada came from so-called "second-growth" stands. These are forests reproduced by natural means, without benefit of silvicultural treatment, following earlier logging operations or forest fires. The yield of wood from Canada's small plantations was insignificant.

DOMESTIC DEMAND FOR FOREST PRODUCTS

It would be difficult, if not impossible, to separate quantities of timber consumed in Canada for war and non-war purposes. Lumber consumed in the manufacture of aircraft or shell-boxes may have reached the scene of battle while lumber used to provide shelter for live stock did not, but Canadian bacon was not less important in its way than Canadian-built Mosquito bombers. From 1940 onwards the whole economy of the country, including the distribution of timber, was organized for the purpose of making as large a contribution as possible to the allied war effort. After providing for exports, supplies of wood were always far short of domestic demands, and available stocks were allocated with a view to promoting maximum over-all efficiency. Non-essential uses of wood practically ceased during the war period.

Lumber

In 1939 the Canadian lumber industry was experiencing a period of reasonable activity, and production during the year was just under 4,000 million board feet. During the logging season of 1939-40 fellings of sawlogs were considerably increased but, on the whole, the industry underwent no dislocation of its normal activities until the early summer of 1940. The German conquest of Norway and Denmark in April and the collapse of French resistance in June radically altered the whole outlook, and the phrase "business as usual" passed into the discard. From this time onward the lumber industry worked under the highest possible pressure and under increasingly difficult conditions.

Canadian construction programs for military establishments and for new munitions factories were at once revised upwards on a scale that promised to tax the construction industry and the suppliers of materials to the utmost. Wood was the chief building material and arrangements had to be made promptly to provide, as well as possible, for the conflicting needs of the different branches of the armed forces, of industry, and of timber exporters. To meet this situation, the Timber Control of the Department of Munitions and Supply was created, and its organization and functions are described at some length in Chapter III.

In 1940 more than 5,000 wooden buildings were erected at bases and training establishments of the Navy, Army, and Air Force, and work was commenced on many new factories and offices. About 430 million board feet of lumber entered into this new construction program and, in addition, 100,000 squares of shingles and large quantities of flooring and millwork were required.

Of special interest was the extensive use of timber frames in the construction of aircraft hangars, drill halls, and other buildings where maximum area of unimpeded floor space was essential. Early in the war, plans for timber-framed hangars, to be fabricated from structural grades of Douglas fir, were approved by the Royal Canadian Air Force and by the Army. Columns and roof trusses were built up from individual members fastened together by means of steel ring-connectors, then a relatively new technique. Most of the hangars had free spans of 112 feet and the use of timber in their construction saved many thousand tons of steel urgently needed for other purposes. The rapidity with which the Commonwealth Joint Air Training Plan was put into large-scale operation would have been quite impossible without the use of these timber frames. The urgency with which work was pressed forward can be judged by the fact that several Service Flying Training Schools, each requiring 6 large hangars and 33 other buildings, were erected within 100 days. In 1940, 335 timber-framed hangars and similar structures were built, and by the end of 1942 the number had exceeded 700.

Another major use for wood which increased rapidly in 1940, and which subsequently surpassed the requirements for war building, was the fabrication of boxes, barrels, and crates. Munitions, food, and other supplies destined for shipment overseas had to be packed in containers strong enough to prevent damage, and motor vehicles and aircraft had to be protected by wooden crates. Domestic lumber requirements for purposes essential to prosecution of the war also included large quantities for shipbuilding, motor truck bodies, construction of aircraft, railway rolling stock, and for essential mines, railway sleepers, and bridges and culverts. All these demands, when added to export requirements, inevitably led to reduction of the quantities of lumber available for ordinary civilian purposes and created a very difficult situation for the

retail section of the lumber trade, although loggers and sawmill operators did their utmost to increase production. The quantities of lumber produced during the war years and the quantities consumed in Canada are shown in the following table:—

LUMBER PRODUCTION, 1939-45
Millions of ft. b.m.

Year	Production	Consumed in Canada
1939.....	3,977	1,842
1940.....	4,629	2,162
1941.....	4,941	2,700
1942.....	4,935	2,796
1943.....	4,364	2,657
1944.....	4,512	2,666
1945.....	4,900*	2,950*

*Preliminary estimate.

During the first half of 1941, the demand for lumber for war building was sharply reduced, but by midsummer a second very active period of construction got under way and continued to the end of the year. During this year 4,000 additional wooden buildings were erected for the armed services. Meanwhile, as munitions output increased, the rate of consumption of lumber for packaging and for miscellaneous industrial uses continued to rise at a rapid rate.

From 1942 onward the direct requirements of the Navy, Army and Air Force for lumber were considerably reduced but by this time many large new factories were coming into production and extensive new housing accommodation had to be provided for their employees. Requirements for shipbuilding rose sharply, and more wood had to be found for the rapidly expanding aircraft industry.

In 1943 production was substantially lower than in previous years in spite of the strenuous efforts of the industry to get out as much wood as possible. Large numbers of key men enlisted in the armed forces and additional numbers found employment in shipbuilding and the munitions industries. Lumbering was declared an essential industry in 1943 and the National Selective Service organization took steps to check the drift of men away from the woods and mills, but a very tight labour situation continued to the end of the war. Other difficulties arose in connection with the obtaining of supplies, restriction of truck haulage, rationing, and so forth, although these were reduced as far as possible through the co-operation of governmental authorities. The partial recovery in 1944 helped to relieve the situation and preliminary estimates of production in 1945 indicate that it was close to the earlier peaks. During 1944 the net quantity of lumber available for consumption in Canada, including about 35 million board feet of imports, amounted to 2,666 million board feet. This was distributed approximately as follows:—

	Million bd. ft.
Military, industrial and residential construction.....	1,270
Boxes and crating.....	640
Mines and railways.....	645
Miscellaneous.....	111

Pulpwood, Wood Pulp and Paper

During the earlier years of the war, production of pulpwood increased by leaps and bounds and the manufacture of wood pulps and papers increased accordingly. In 1941 the production of the pulp and paper industry exceeded all previous levels, both in volume and in value. The large increases in production and exports of all kinds of wood pulps, and of paper-board and papers other than newsprint, were particularly notable. The exceptional demand for pulp made necessary the installation of additional manufacturing facilities at existing mills. No entirely new mills came into production during the war.

The trends of production of pulpwood, wood pulp and paper are shown in the following statement:—

PRODUCTION OF PULPWOOD, WOOD PULP AND PAPER

Year	Pulpwood	Wood Pulp	Newsprint Paper ¹	Other Paper ²
	Thousand Cords	Thousand Tons	Thousand Tons	Thousand Tons
1939.....	6,900	4,166	2,927	674
1940.....	8,500	5,291	3,504	816
1941.....	9,545	5,721	3,520	1,010
1942.....	9,654	5,606	3,257	975
1943.....	8,801	5,273	3,046	920
1944.....	8,669	5,271	3,040	1,005
1945.....	9,146	5,601	3,324	1,036

¹ Including small quantities of hanging and poster paper and side rims for pulping, prior to 1944.

² Including paper boards.

Up to the end of 1941, war conditions intensified the demand for products of the pulp and paper industry, but did not result in any major disturbance of normal operating and trading practices. While the armed forces, other government departments, and the munitions industries, required more paper of all kinds, these products continued to be distributed through normal trade channels.

A special contribution to the general war effort was made by the pulp and paper industry by the manufacture of "bits and pieces" in its extensive and well-equipped machine shops. The diversified list of products manufactured included parts for naval and cargo vessels, for aircraft, gun-mountings, gauges, and other special devices. During the first year of operation, this program provided supplies valued at more than \$1,250,000, and output in subsequent years was much greater.

In 1942 the steadily rising demands of both domestic and export markets on the one hand, and developing shortages of labour on the other, combined to create a situation in which some measure of government control was necessary. Production and distribution of pulpwood were placed under direction of the Timber Controller of the Department of Munitions and Supply and all business in wood pulps and papers was placed under the control of administrators of the Wartime Prices and Trade Board.

Newspaper mills are very large consumers of hydro-electric power. In spite of the tremendous output of Canada's hydro industry, the needs of munition industries and other plants engaged in direct war production became so great in 1942 that the amount of current available to newspaper mills in Ontario and Quebec had to be restricted. This inevitably resulted in reduction of the quantities of newspaper paper manufactured. The situation was relieved in 1943 when large new hydro-electric plants came into operation.

Shipments of newspaper paper for consumption in Canada were limited to approximately six per cent of the total of all shipments annually throughout the war, this being the pre-war proportion. All the rest of the large output was exported. On this basis shipments for Canadian consumption averaged 194,000 tons annually in the years 1940 to 1945 inclusive.

Fuel-wood

About half the people of Canada use wood fuel to heat their homes. Annual production of roundwood totals from 9,000,000 to 9,500,000 cords and, in addition, the equivalent of 1,500,000 to 2,000,000 cords of sawmill refuse (slabs, sawdust and hogged fuel) is consumed. About 30 per cent of the total volume of wood taken from Canada's forests each year is fuel-wood. The chief producers of cordwood are farmers, and the larger part of their output comes from their own woodlots. Fuel-wood is normally cut in the autumn and early winter, after the crops are harvested, and allowed to season for some months before it is brought to market. During the war the drain of man-power from the farms into the armed services and munitions plants resulted in a steady decrease in the output of fuel-wood. Canada experienced a particularly severe winter in 1942-43 and, because of declining supplies, a crisis developed. Responsibility for dealing with the situation was assigned in the first instance to the Wartime Prices and Trade Board; in 1943 this control was transferred to the Department of Munitions and Supply.

The Government entered directly into the production of fuel-wood and for some time maintained emergency stock piles in those parts of Canada where normal production proved inadequate. In general, however, the policy was to encourage normal production and distribution and to use government reserves only as a last resort to prevent suffering. During the next two years more adequate supplies became available, but adverse weather conditions in Eastern Canada curtailed production in the fall and winter of 1944.

Special Products

During the war of 1914-18, Sitka spruce, which grows only on the west coast of Canada and the United States, was found to be the best wood for the fabrication of structural components of aircraft. Even though the greater number of aircraft used during the war of 1939-45 were of metal construction the demand for spruce was even larger than formerly.

Very little aircraft spruce was used in Canada in 1939 and 1940 and production for export was carried on through normal commercial channels. By 1942, however, developing shortages of this material were threatening aircraft programs both at home and in the United Kingdom. After conference with British officials, the Canadian Timber Control sponsored the formation of a Crown company, known as Aero Timber Products Limited, to engage directly in logging and to take any other steps which seemed likely to expedite the production of Sitka spruce.

Selected logs of yellow birch, one of the most widely distributed hardwoods in Eastern Canada, were found to be most suitable for the production of veneers conforming with the very exacting specifications required for use in aircraft plywood. About 80 per cent of the requirements of the United Nations for birch veneer logs was provided in Canada, the remainder coming from the United States. From 1942 onward the whole Canadian output of birch veneer logs was controlled by a Crown company known as Veneer Log Supply, Ltd.

Veneer logs produced in 1943 totalled about 15,000,000 feet, board measure. During the war there were eight Canadian companies producing aircraft veneers, with a combined annual capacity of approximately 300,000,000 sq. ft. Four companies manufactured approximately 35,000,000 sq. ft. of aircraft plywood each year.

Early in 1942, supplies of Douglas fir plywood, widely used in buildings, ship construction and for many other purposes, became very short. To meet this situation the whole Canadian production was taken under control and all orders were made subject to allocation. It was found necessary to discontinue supply of this commodity to all civilian projects. Until the early part of 1944 two Canadian companies operated three fir plywood mills with an annual production of about 160,000,000 sq. ft. In that year one of the aircraft plywood plants was changed over to Douglas fir plywood and overall production was stepped up to approximately 200,000,000 feet.

In order to secure the highest possible production in Canada all producers of Douglas fir logs on the west coast were required to make all large logs of suitable quality available to the plywood mills. Export of fir "peeler" logs was prohibited.

Production of pit-props on a large scale was undertaken for the first time in Canada in 1939. This action was made necessary by the obvious danger that Britain might be cut off from her normal source of supply in the Baltic by enemy action. Although the somewhat exacting specifications for pit-props were unfamiliar to operators in Eastern Canada, 25,000 fathoms were produced in the first operating season and 240,000 fathoms (405,000 cords) in the following year. This wood was produced under contracts placed by a British company known as Pit Wood Export Limited, with offices in Moncton, N.B. Production was halted for a time because of difficulties in securing shipping space, but by the end of the war Canadian pit-props were again being shipped to coal mines in the United Kingdom.

EXPORT DEMAND

In the early days of the war exports of forest products were encouraged for the purpose of increasing Canada's limited reserves of foreign exchange. Canada's forest industries provided the means for securing foreign credits, and particularly dollar credits, which were necessary for the purchase of large quantities of war equipment, machine tools, and other products which could not, at that time, be produced at home. To still further improve the balances derived from forest products, imports were strictly controlled. In later years, however, and particularly after the United States had become a belligerent, it was necessary to restrict exports to non-Empire countries through a system of export permits. Only thus was it possible to ensure sufficient supplies for the United Kingdom and for the prosecution of Canada's own war effort. In the case of lumber, this system had to be retained after the end of hostilities.

Log Exports

In pre-war years the volume of exports of sawlogs from Eastern Canada was small, but exports from the west coast of British Columbia were substantial. The larger part of such exports was sold in the United States. In 1940 the necessity for increasing output at home, together with an increased demand for Canadian logs from other countries, made it necessary to impose restrictions on exports of Douglas fir logs. These restrictions were relaxed to some extent in 1941 but had to be reimposed before the year was out.

Exports of logs of all kinds from all of Canada during the war years were as follows:—

LOG EXPORTS		Thousands of ft. b.m.
Year		
1939.....		330,779
1940.....		234,233
1941.....		329,279
1942.....		153,297
1943.....		65,402
1944.....		87,843
1945.....		57,680

Pulpwood Exports

Exports of pulpwood during the war years are summarized in the following table*:—

PULPWOOD EXPORTS		Rough Cords
Year		
1939.....		1,539,440
1940.....		1,551,429
1941.....		1,856,393
1942.....		1,987,851
1943.....		1,540,593
1944.....		1,499,136
1945.....		1,671,298

From 1943 onwards all the pulpwood exported went to the United States. It will be noted from the above figures that exports to that country reached a peak in 1942. Since labour shortages in Canada made it clear that the current level of production could only be maintained with the greatest difficulty, if at all, and since heavy withdrawals from pulpwood inventories had already been made, it was necessary to restrict exports in subsequent years. Arrangements were made, however, whereby United States mills which normally depended on Canadian wood would continue to receive normal supplies based on their average purchases during the preceding seven years. In agreement with United States authorities, Canadian exports of pulpwood were stabilized at from 1,500,000 to 1,600,000 cords annually for the remainder of the war.

Other Roundwood Exports

Prior to the outbreak of war, exports of birch veneer logs to the United Kingdom amounted to about 10,000 tons annually. These increased to 25,000 tons in 1940 and reached a peak of 60,000 tons in the following year. Annual shipments of veneer logs to Great Britain in the remaining war years amounted to approximately 35,000 tons, but production of finished veneers and plywoods in Canada was greatly expanded.

*This does not include the export from British Columbia of logs intended for pulpwood.

Starting on a modest scale in 1939, export of Canadian pit-props to Britain amounted to about 230,000 fathoms (388,000 cords) in 1941. This left about 120,000 fathoms in stockpiles in Canada, for which no shipping space was available. In the following year about 40,000 fathoms were sent overseas and the remainder, equivalent to 135,000 cords, was released to pulp companies in Canada and the United States.

Lumber Exports

Since the beginnings of the Canadian lumber industry, a large proportion of its total output has been sold in external markets, the chief importing countries being the United Kingdom and the United States. Quantities of lumber exported in the pre-war period and the war years are summarized in the following table:—

EXPORTS OF CANADIAN LUMBER

Thousands of ft. b.m.

Year	To United Kingdom	To United States	To all Other Countries	Total
Average 1934-38.....	919,082	421,078	359,645	1,699,805
1939.....	1,223,974	627,087	380,872	2,211,933
1940.....	1,616,909	651,315	280,457	2,548,681
1941.....	826,804	1,231,588	242,483	2,300,875
1942.....	647,392	1,432,128	100,436	2,179,956
1943.....	902,539	730,479	108,258	1,741,276
1944.....	851,537	878,603	152,379	1,882,519
1945.....	878,663	929,417	192,982	2,001,042

Exports to the United Kingdom were exceptionally large in 1939 and reached the greatest volume on record in the following year. In subsequent years the movement of Canadian lumber across the Atlantic was restricted by shortages of shipping, but Canada continued until the end of the war to be the chief source from which Great Britain could obtain softwood imports. Purchases for British account were negotiated by representatives of the British Timber Control, but the Canadian authorities undertook to do everything possible to see that British needs were met. A large proportion of the lumber exported to the United Kingdom originated in British Columbia, but the abnormal demand for shipping space and the heavy losses of tonnage due to enemy action made it impossible for vessels to spend the time needed for the long voyage through the Panama Canal and up the west coast of America to Vancouver. Negotiations with the railway companies resulted in the adoption of special rates for transcontinental movement of lumber by rail from British Columbia to eastern ports and quantities as high as 80,000,000 board feet were hauled across the continent, a distance of more than 3,000 miles, in a single month.

United States imports of Canadian lumber were only slightly larger in 1940 than in the previous year. During 1941, however, they were increased by 100 per cent to meet the needs of the rapidly expanding preparedness program. Up to this point such exports had been encouraged in order to secure United States dollar exchange for war purposes, and because the decline of shipments to the United Kingdom had made disposable surpluses available. After Pearl Harbour the American demand for Canadian lumber increased still further, but meanwhile the upward trend of production had been checked by internal difficulties. The drain became so great in 1942 that supplies for the United Kingdom and for Canada's own war effort were jeopardized. It became necessary, therefore, to bring exports to non-Empire countries under control and since November 9, 1942, all exports of lumber to such countries have been subject to the prior issue of export permits.

When the war started, practically all of the aero spruce lumber produced in Canada was exported to the United Kingdom under contracts arranged by the representative of the British Timber Control on the west coast. The total quantity, however, was not large. In the peak year of production, 1943, two-thirds of the total output, or about 16,000,000 ft. b.m., of this very high quality material was sent to the United Kingdom and part of the remainder was distributed on an allocation basis among Australia, New Zealand, and South Africa.

Pulp and Paper Exports

The Canadian pulp and paper industry is more heavily dependent on export markets than the lumber industry. More than nine-tenths of the total output of its chief product, newsprint paper, is sold in other countries, by far the most important outlet being in the United States. Canadian exports of wood pulp increased greatly during the war because of increased needs of the war production programs and also because buyers in countries outside continental Europe were unable to obtain their accustomed supplies from the Scandinavian and Baltic countries. In 1943 Canadian exports of pulps were almost three times as great in volume and nearly four times as great in value as in 1938. The quantities of mechanical and chemical pulp and newsprint paper exported during the pre-war period and in each of the war years are summarized in the following table:—

EXPORTS OF WOOD PULP AND NEWSPRINT PAPER

Thousands of tons

Year	Mechanical Pulp	Chemical Pulp	Newspaper Paper
Average 1934-38.....	134	556	2,772
1939.....	169	537	2,659
1940.....	204	864	3,243
1941.....	271	1,141	3,262
1942.....	278	1,232	3,005
1943.....	273	1,284	2,810
1944.....	237	1,172	2,806
1945.....	274	1,161	3,059

During the war years the average annual value of exports of pulp and paper (exclusive of books and printed matter) was \$250,126,086. The value of imports of these commodities averaged \$11,632,557. The pulp and paper industry, therefore, provided an average favourable balance in external trade of \$238,493,529, including more than \$167,000,000 in United States funds. This large volume of American exchange was of vital importance to the whole Canadian war effort, particularly during the period prior to Pearl Harbour, when war supplies purchased in the United States had to be paid for in cash. Here it may be mentioned that at no time did Canada accept "lend-lease" assistance from any source; on the contrary, her own program of assistance to Empire and Allied countries, known as Mutual Aid, assumed very large proportions.

CHAPTER III

Wartime Controls

TIMBER CONTROL

During the first months of the war no special controls governed the activities of the forest products industries of Canada. This situation continued until the collapse of the western front in June, 1940. Immediately after that date a Timber Controller was appointed in the Department of Munitions and Supply, and a month later the Timber Control Branch was organized and functioning. Control of the pulp and paper industry did not become necessary until the end of 1941, and was exercised thereafter by the Wartime Prices and Trade Board, which had come into being in November of that year.

The Timber Control Branch of the Department of Munitions and Supply was established to forestall chaos in the home timber market and to ensure that the flow of lumber urgently needed for war purposes in the United Kingdom would not be interrupted. The Branch operated as a unit of the Wartime Industries Control Board, of which the Timber Controller was a member. All Timber Control orders were supported by the authority of the Board.

The first Timber Controller was the head of one of the largest timber producing and exporting firms in British Columbia. The original organization was staffed by twenty-seven prominent members of the lumber industry, two members of the Dominion Forest Service, and one member of the Department of Lands and Forests of British Columbia. Composition of the staff ensured that all matters dealt with by the Control would be considered by men of wide practical experience and that unnecessary friction and delays would be avoided. The services of most of these men were made available by their companies or trade associations without cost to the Department.

Regional committees of members of the lumber trade were appointed in the principal lumber-producing regions to advise and assist the Controller in the formulation and execution of his policies. These committees functioned throughout the war and gave most valuable assistance. Regional offices were established in Vancouver, British Columbia; Edmonton, Alberta; Winnipeg, Manitoba, and Saint John, New Brunswick.

Immediately after the fall of France, Canadian construction programs for the building of new military establishments and munitions factories were revised upwards on so large a scale that the problems presented by the urgent and conflicting needs of the various services obviously could not be solved through the normal procedures of a free market.

When the Control came into existence it was confronted by three major problems. First, arrangements had to be made for maintaining shipments of lumber to the United Kingdom; secondly, timber had to be secured and distributed for Canada's own war building program, including the British Commonwealth Air Training Plan, and thirdly, exports of lumber to non-sterling countries had to be encouraged because of the urgent need for foreign exchange. In addition, sufficient lumber had to be found for essential civilian business.

With respect to supplies for the United Kingdom, contracts were placed with Canadian firms by agents of the British Timber Control, the Canadian organization lending such assistance as was necessary to ensure that the British buyers would obtain all the lumber that available ships could carry. Arrangements were made with Canadian railroads for hauling lumber from British Columbia to eastern ports to speed up deliveries and save shipping.

Lumber and millwork required by the Army for the organization of new training schools and other facilities were purchased outright by the Department of Munitions and Supply through the Timber Control and construction was undertaken by the Royal Canadian Engineers. On the other hand, new establishments for the Royal Canadian Air Force, including the Air Training Plan, were erected by the construction industry under contract, and it was the function of Timber Control to ensure that the contractors could purchase the lumber they needed and obtain deliveries without delay.

Great care was taken to avoid "cross-hauling" of lumber. This was necessary to ensure quick delivery and to ease the strain on heavily overburdened transportation systems. A great deal of structural timber of large dimensions had to be secured from British Columbia for use in other parts of the Dominion but, aside from this, the policy was to buy lumber for each project from the closest source of supply. Specifications for buildings and for all articles made of wood were rigidly scrutinized, and many changes were made that effected considerable savings in materials and money without in any way detracting from the serviceability of the structures concerned.

In order to maintain production in Canadian sawmills and plywood plants, it was found necessary to restrict exports of large Douglas fir logs from the west coast. Later, the acute shortage of Douglas fir plywood compelled entire prohibition of the exportation of fir logs of "peeler" quality. Restrictions were also placed on exportation of Western hemlock logs which ordinarily moved south in relatively large quantities for consumption in pulp mills in the United States.

The greater part of the first emergency construction program was completed by the end of 1940, but in midsummer of the following year a second very active period of war building commenced, continuing for six months. During the remaining years of the war the need for lumber for war purposes in Canada did not diminish but the purposes for which it was required changed considerably.

At the end of 1941, pulpwood operations in Canada were brought under the direction of the Timber Control because of the increasing danger of shortages of raw material for the pulp and paper industry. An Assistant Timber Controller in charge of pulpwood was appointed and consultative committees were set up in the principal pulpwood regions east of the Rocky Mountains. Exports of pulpwood to non-Empire countries were made subject to permit.

In the latter part of 1942 it became apparent that the problems facing the Control were changing in character, or at least in relative emphasis. As the problems of procurement of timber were gradually overcome, questions relating to control of exports and prices assumed greater importance. In consequence, the Timber Control head office was extensively re-organized in November, 1942. Separate divisions were established to deal with exports, procurement and allocation, hardwoods, plywoods, aircraft spruce, pulpwood, statistics, and other matters. Early in 1944, the control of fuel-wood, originally handled by the Wartime Prices and Trade Board, was placed under Timber Control.

At the time of re-organization Canadian timber supplies were under very great pressure because of the almost limitless demand in the United States. Steps were taken, therefore, to establish close working contact with the appropriate authorities in that country and to reach agreement respecting the quantities of lumber, pulpwood, and other forest products which Canada could supply to her great neighbour without crippling her own war effort. Agreement was also necessary with respect to quantities of certain types of wood which Canada was to secure from the United States. These agreements were revised from time to time during the remainder of the war.

A series of Timber Control orders issued in 1943 required manufacturers and wholesale dealers in lumber to obtain prior approval from Timber Control before completing any sale or delivery of goods. In this year a difficult problem arose in connection with supplies of crating, because of the great expansion of shipments of Canadian vehicles to all war theatres. About 200 million surface feet of crating stock, 11/16" in thickness, were required and the normal sources of supply in eastern Quebec and the Maritimes were unable to meet the need in full. Arrangements were made for securing additional supplies from Ontario and the seasonal producing areas of Western Canada.

Control of Prices

At the commencement of Timber Control operations in 1940, the Controller made arrangements with the lumber industry on the west coast whereby domestic prices were stabilized at levels prevailing in June of that year. Agreements for maintenance of June prices, so far as government business was concerned, were also made with regional committees in Eastern Canada. Although the later arrangement did not extend to non-government business in the East, the fact that Timber Control was by far the largest purchaser and did not buy above June levels had a steady effect on prices to all consumers. The results of this informal system of price control, which was only made workable by the co-operative attitude of the lumber industry, were remarkably good. The general lumber price index in Canada stood at 105.8 in July, 1940, and reached a peak for the year of 109.2 in November, an increase of only 3.4 points.

During the winter of 1940-41, higher operating costs in Canada and the higher level of prices in the United States combined to exert considerable pressure on the domestic price structure. A more rigorous system of price control was, therefore, introduced through a series of orders issued by the Timber Controller. Maximum prices for different species and grades of lumber and for different regions were determined after full consultation with the industry, and administration of the regulations was handled chiefly through the regional committees.

In order to prevent great increases in domestic prices, such as had been experienced during the war of 1914-18, and to reduce the danger of post-war inflation and subsequent collapse, the Wartime Prices and Trade Board was established by the government on December 1, 1941. This was an entirely new government agency, the Board reporting through its chairman to the Minister of Finance. All retail prices were frozen as at April 1, 1941. Administrators were appointed by the Board to control prices of specified commodities, the Timber Controller becoming administrator of prices of lumber and allied products.

When formal control was introduced, domestic prices for lumber were substantially lower than those in export markets and this situation continued throughout the war. Costs of production, however, increased as the war went on and from time to time certain adjustments were necessary in order to enable manufacturers and dealers to continue in operation. In order to prevent increases of prices to consumers, certain subsidies were paid to retailers by the Commodity Prices Stabilization Corporation.

Since prices in export markets were well above Canadian levels and, at the same time, war needs in Canada were great, somewhat elaborate control procedures were necessary to ensure that each individual manufacturer obtained his fair share of export business, but no more.

Production costs had risen sufficiently in 1943 to justify a general upward adjustment of lumber prices, and this included authorization of increased retail prices in place of subsidies. It was announced, however, that there was no intention of granting further increases until the end of the war and, with the exception of a few cases of extreme hardship, this policy was successfully carried out.

No ceiling prices were established for sawlogs in Eastern Canada because all but a small proportion of such logs were produced by lumber manufacturers. Ceiling prices for logs were established on the west coast and certain upward adjustments were authorized during the course of the war to compensate producers for increasing costs. Ceiling prices for pulpwood and for

fuel-wood were established on a regional basis, after consultation with advisory committees. As in the case of lumber, domestic prices for pulpwood were held at levels considerably below those prevailing in export markets.

Administration of Pulp and Paper

Control of Canadian prices involved a considerable degree of regulation over distribution of material in short supply, and this was particularly true in connection with commodities for which there was a large export demand. In the case of commodities over which no formal control had been established in the Department of Munitions and Supply, administrators appointed by the Wartime Prices and Trade Board exercised regulatory authority. The distribution of pulp and paper was controlled by a number of administrators under the overall direction of a co-ordinator.

In 1942, the needs of munitions industries and other direct war production were so great that restrictions had to be placed on the amount of hydro-electric power which could be supplied to newsprint mills in parts of Ontario and Quebec. This inevitably resulted in reduction of the quantities of newsprint manufactured. To meet this situation, the Newsprint Administrator entered into negotiations with United States authorities with a view to bringing the whole newsprint industry of North America under a more or less uniform system of control. In Canada, plans were made for a pooling scheme whereby mills that had been compelled to surrender business through lack of power, raw materials, or other essential facilities would be compensated from a fund built up from contributions from mills that were able to maintain or increase their output. This fund was administered by the Commodity Prices Stabilization Corporation of the Wartime Prices and Trade Board.

Early in 1943 a quota arrangement covering twenty-five mills was put into effect. Nevertheless, the reduced rate of operation of the industry as a whole placed Canadian manufacturers in a very difficult position because there had been no increase in the standard price of newsprint (\$50 per ton at New York) since 1938. During the intervening period costs of operation had risen steadily and a price increase of \$4 per ton was authorized by United States authorities, effective March 1, 1943. Subsequent authorizations brought the price up to \$63 per ton by the end of the war.

In the early summer of 1943 large new hydro-electric plants came into operation, substantially easing the power situation, but no considerable increase in the output of pulp and paper then seemed possible because of lack of woods labour and consequent shortage of pulpwood. Shipments of newsprint to the United States were stabilized at 210,000 tons per month and, with variations depending on existing conditions, were maintained at approximately this rate throughout the remaining war years.

SPECIAL AGENCIES

In the course of the war two Crown companies, Aero Timber Products Limited and Veneer Log Supply Limited, were established by the Department of Munitions and Supply at the request of the Timber Controller. A third special agency, which provided subsidy payments to retail lumber dealers and to fuel-wood dealers in order to stabilize consumer prices, was the Commodity Prices Stabilization Corporation of the Wartime Prices and Trade Board.

Aero Timber Products Limited

This company, which had its headquarters in Vancouver, British Columbia, was organized in June, 1942, to expedite logging of Sitka spruce in the Queen Charlotte Islands. At the beginning of the war nearly all aircraft spruce produced in Canada was exported to the United Kingdom under contracts arranged by the British Timber Control through their own representatives. With the increase of production of wooden aircraft in Canada, substantial quantities of this wood were needed by domestic manufacturers. In order to provide sufficient spruce for the British and Canadian aircraft industries, production had to be substantially increased and the Crown company entrusted with the task had a very successful record. Output in 1943 amounted to 24,686,000 board feet, as compared with 16,000,000 during the previous year. In the spring of 1945 the demand for Sitka spruce had dwindled to a point which permitted the winding up of the company.

Veneer Log Supply Limited

The aircraft industries of Britain and Canada required large quantities of plywood for covering wings and fuselages. In building up plywoods for this special use, veneers of exceptionally high quality were needed and it was found that the yellow birch of Eastern Canada provided the most suitable wood. Production of logs acceptable for the manufacture of aircraft veneers is difficult and expensive because only occasional trees are large enough and of sufficiently high quality to meet the requirements. To stimulate production and to secure the best possible allocation of available supplies, Veneer Log Supply Limited was established in August, 1942, with headquarters at Montreal. All producers of veneer logs, including sawmill operators, were required by law to offer their veneer logs to the company. Through this arrangement sufficient logs were secured for Britain and for Canada and the company was able to wind up its operations in 1945.

DEVELOPMENT OF RESOURCES

The tremendous expansion of air travel in Canada during the war years created a demand for map coverage of Northern Canada which resulted in an extensive air photographic program

by the Royal Canadian Air Force and the United States Army Air Forces. While the trimetrogon system of air photography which was employed was not directly applicable to forest type mapping, it did provide provisional maps upon which could be plotted the flight lines for subsequent vertical photography. In 1944 and 1945 the R.C.A.F. photographed the Province of New Brunswick, using vertical photography. These photographs are being utilized for forest type mapping, and forest management purposes. The application of the vertical photograph to forest mapping is discussed more fully in Chapter VIII.

ECONOMY IN USE

Immediately following the establishment of Timber Control in Canada, it became apparent that the greatest possible economy in the use of available wood supplies would be essential. Accordingly, all plans for wartime buildings were scrutinized, and lower grades of lumber were substituted wherever this could be accomplished without reducing the utility or durability of the structures concerned. It was found, for example, that in many cases grades of lumber for use in positions which would not be exposed to the weather could be lowered without any unfavourable consequences. Designs and specifications for all articles made of wood were also examined and many substantial savings effected.

The acute shortage of shipping space made savings in bulk even more important than savings in lumber as a material, and at the request of Timber Control the Forest Products Laboratories redesigned many types of containers, such as shell boxes, and in many instances were able to achieve reductions in volume and in material and, at the same time, increases in strength. This program alone saved many thousand tons of shipping space.

In connection with the shipbuilding program it was necessary to substitute Canadian hardwoods for the traditional teak when the latter became unobtainable. Reports on performance of the wood under service conditions were very satisfactory.

Important savings of valuable hardwood stock were effected through the careful study and revision of kiln-drying schedules. In this way procedures were elaborated which substantially reduced losses and increased output.

The great bulk of plywood and veneer used in aircraft construction programs in the United Kingdom, Australia and Canada was made from Canadian yellow birch. In the face of limited supplies and increasing demands, however, it soon became evident that substitute species would have to be used. In Eastern Canada it was demonstrated that logs of sugar maple and white birch, of suitable size and quality, could be used for the production of veneers conforming to the very exacting specifications necessary for aircraft work. In British Columbia, Western white birch was also utilized to a considerable extent in the thinner plywood constructions. The very rigid plywood specifications in force at the beginning of the war had to be broadened in various ways, notably to include the use of alternative species. This was successfully accomplished without detriment to the final product.

The restricted supply of Sitka spruce also made necessary the consideration of alternative species, and Canadian specifications were adopted which permitted the use of Engelmann spruce, red spruce and white spruce. While full advantage was not taken of these relaxations, these other species were in fact used to a considerable extent.

The extreme shortage of aircraft species brought about another interesting development in connection with material selected for spar construction. As a means of saving the considerable amounts of material lost in dressing rough lumber, experiments were carried out in the smooth sawing of stock. These efforts met with notable success and glue-line strengths were achieved which compared favourably with those obtained under normal conditions with dressed stock.

The development of moulded plywood construction for several types of aircraft required the use of a moderately light-weight wood with characteristics comparable with those of yellow poplar, which was not available in Canada. Native red pine was used with excellent success.

In the sawmill industry on the west coast, war conditions stimulated the use of larger quantities of logs of small diameter, which formerly were left on the ground to rot. A large-scale operation was conducted on an experimental basis to salvage pulpwood from the debris left behind by a normal logging operation. This project succeeded in salvaging a volume of about 18 cords per acre, and is likely to prove the forerunner of much closer forest utilization on the coast, although a great deal of work remains to be done before such salvage jobs can be considered entirely practical from the economic point of view.

THE WORKING OF NEW FORESTS

The accessible forests of Canada, unlike those of many other parts of the British Empire and the older countries of Europe, contain timber resources which are far in excess of the present industrial requirements. The impetus given to timber production by wartime demand, with its accompanying higher price levels, undoubtedly resulted in the construction of roads, particularly on the west coast, into areas which under peacetime conditions would not have been logged for several years to come.

Mention has already been made in this chapter of the production of yellow birch veneer logs required in the manufacture of plywoods for the aircraft industry. In order to obtain logs of the requisite high quality it was found necessary to comb extensive areas which had been logged for softwood species. These forests were thus being re-worked for residual species which were not previously exploitable.

In no other case could it be claimed that new forests in Canada were worked as a war measure.

NEW USES AND SUBSTITUTIONS OF TIMBER

The acute materials situation that developed because of the war, especially in the earlier phases of the European conflict, necessitated the close utilization of all available construction materials and, in many instances, compelled the substitution of more easily obtainable materials for others in short supply.

Expansion of air training establishments required the provision of aircraft hangars in such numbers that available supplies of structural steel were quickly exhausted. Since steel was an essential material in other branches of the war effort, an attempt was made to find suitable substitutes. As with steel, there was an enormous drain upon timber supplies, but by special effort large quantities were produced, which, though largely unseasoned, were nevertheless used to construct the trusses, columns and necessary coverings for the large number of hangars required.

The timbers were pressure-treated with zinc chloride to assist in reducing to some degree the checking expected as a result of seasoning in place, and to reduce somewhat the combustibility of the timbers. The structures were designed to use ring connectors and proved adequate for the imposed loads. The number of truss failures reported was small and those occurring resulted from inadequate inspection or lack of proper supervision during or after erection. In some instances connectors had been omitted during construction, in others no attempt had been made to tighten the connector bolts as the timbers seasoned, with the result that occasionally connectors which had overturned or had withdrawn from their housings in the wood were found.

Timber beams and trusses were used in industrial buildings erected during the war years to further relieve the steel shortages. These have proved completely satisfactory and though costs were necessarily far from normal, the expense involved in fabricating such trusses was not out of line with steel construction during the same period.

With the demand for larger timbers increasing and the supply becoming less abundant, attention was turned to the possibilities of laminated construction. European practice was known favourably among timber engineers, but not a great deal of experience was available among contractors, and opinions differed as to the merits of laminating small timbers to produce solid beams of large sizes. Some experimental work had been under way in the United States before the war, and later laminated beams of considerable size were constructed. This development of the laminated beam was viewed hopefully among engineers in Canada, as providing an answer to the diminishing supplies of large high-grade timbers, and as opening up a new field for the utilization of smaller components in structural work. Beams up to forty feet have been successfully produced, and there is no doubt that, with more experience in this field and with the concurrent improvement in adhesives, the practice of laminating large structural members will steadily increase.

The lamination of aircraft spars was a natural development occasioned by the reduced supply and increasing demand for strong, light aircraft components. Whereas clear Sitka spruce beams were fairly plentiful in the war of 1914-18, the war of 1939-45 found Canada with only meagre supplies of sufficiently large high-grade timbers in sight. Increasing weights of aircraft meant either new materials or new timber design for spars. Laminating thin spruce timbers resulted in a satisfactory solution of this problem and large laminated and box-beam types of spars were developed, of sufficient strength to meet all the requirements of the growing aircraft industry.

While casein glues have been almost universally employed in Europe as the adhesives for building structural members and have proved eminently satisfactory, the production of reasonably priced phenolic adhesives of the cold-setting type, which are completely moisture-proof and not affected by bacterial growth or decay, has influenced in no small degree the acceptance of glued laminated wood as a valuable structural material. Present trends indicate that, even for smaller elements, considerable interest is being taken in the development of laminated timbers for structural purposes.

The production of special laminated shapes such as arches has also received attention. The simplicity of structures supported by laminated arches makes them suitable for smaller commercial or industrial buildings, halls, auditoriums, churches and similar structures, while some economies can be made in certain types of agricultural buildings such as barns, where unobstructed loft space is advantageous. While such buildings as the last-mentioned are in the experimental stage, a number of large laminated timber arch structures have been built in the United States and several companies in Canada are ready to supply arches of the three-hinged type upon request.

In the field of structures the more scientific use of plywood must not be overlooked. Structural panels of plywood have been increasingly used in concrete forms because of the ease with which large plain areas can be framed and also because of the clean appearance of the finished concrete.

Sub-floors are now constructed of softwood plywood, and its utilization for this purpose, though restricted at present by availability of supplies, will undoubtedly be increased. The large areas which can be covered quickly with the minimum labour make plywood a very desirable material for housing construction wherever time must be reduced to a minimum.

Walls also are being constructed with plywood. Here again, the time involved in sheathing a building with plywood is considerably less than that required to sheathe walls with rough lumber nailed over a building paper. Plywood, readily procurable in large, joint-free sections, presents a wind-proof surface to the elements, and can be applied so rapidly that it is quickly winning the approval of builders in Canada.

National Selective Service was established as an overall agency to cope with manpower problems. The increasing signs of labour shortages also made woods operators conscious of the fact that special steps were needed to encourage more workers to enter the industry, as well as to ensure the most effective use of available manpower.

Wartime Manpower Regulations Affecting Woods Employment

One of the first regulations introduced under National Selective Service froze essential workers, including farmers, to their jobs. Important, however, from the standpoint of forest industries, was a provision that agricultural workers could obtain permission to accept off-seasonal employment in other essential industries, including woods work.

Another important step taken during the summer of 1942 was the establishment of labour priorities. These priorities were set up as guides to local National Selective Service officials in allocating labour. All industries were given one of four labour priority ratings:

- A—Very high priority
- B—High priority
- C—Low priority
- D—No priority

In the spring of 1944 an A(e) priority rating, introduced as an emergency classification, was accorded for temporary periods to industries having extremely critical labour requirements.

At the time of establishment of labour priorities in 1942, logging and sawmilling operations producing wood for aircraft manufacture, and all lumbering operations in coastal British Columbia, were rated as "A" priority. All other woods operations, except pulpwood, were included in "B" priority. Pulpwood production was given a "C" priority. Practically all these lower categories for log production and sawmilling were improved as the war progressed.

Another regulation required all persons to obtain labour exit permits before seeking employment outside the country. Under this regulation provision was made for a limited number of men from rural areas in Quebec to engage in woods operations in nearby areas of the State of Maine. Otherwise, men experienced in woods work were not permitted to leave Canada as civilians, unless under compassionate circumstances.

Special consideration was also given to the woods industries by a 1943 ruling enabling men granted postponement of military training to work in agriculture to engage in logging operations during the off-seasonal months, provided they returned to their farms in time for spring work.

While strict limitations were imposed on advertising and recruiting by employers, those in the woods industries were permitted some latitude to undertake publicity and recruiting in outlying areas under National Selective Service supervision.

Rural workers, some distance from local employment offices, were allowed some freedom in going directly to woods jobs, with the necessary "application for work permits" being mailed to National Selective Service instead of the workers going to local offices in person beforehand.

The manpower requirements were further modified during the summer of 1945, when woods employers were required to report only hirings and separations on a simple form. With a general relaxation of controls, following the end of hostilities, this method of reporting hirings was adopted for all employers.

Towards the end of the war the Industrial Selection and Release Committees afforded some assistance to the forest industries in facilitating the release of key personnel in the armed forces for work in industry. In view of the tremendous demands for men and material in the housing and construction industries, favourable consideration was given to requests for the release of men experienced in the logging and building trades.

Woods Labour Program

A broad woods labour program, based in part on the above regulations, was initiated by the Department of Labour in the fall of 1942. This program was under the supervision of the Associate Director of National Selective Service in charge of Agriculture, Forestry and Fisheries.

Under annual Dominion-Provincial Farm Labour Agreements, it was arranged as part of the woods labour program for provincial agricultural and other local personnel to assist National Selective Service in recruiting rural workers for the woods industries.

Publicity campaigns in co-operation with the provinces and the industry were undertaken each autumn through the press, radio, posters, pamphlets, and films. The need for woodsmen was emphasized, as well as the conditions under which employment was available for farmers and others. During the spring and summer months woods operators were generally asked to co-operate in releasing men for farm work, but assistance was given in securing men for river drives, necessary improvement work in the woods, and for sawmilling. As the war progressed the publicity programs were altered according to changing conditions. As an example of this, in the fall of 1945 special appeals were directed to men released from war industries and from the armed services to accept woods work.

As a special incentive to workers to accept woods employment transportation was occasionally advanced or paid entirely by the government. This transportation assistance, for example, was given to men from the Prairie Provinces and other areas to go to British Columbia woods operations, where, owing to the size of the timber and the logging methods used, production per man is particularly high.

Under the chairmanship of the Associate Director of National Selective Service a Woods Labour Committee was set up in April, 1944, to aid the Department in an advisory capacity on matters relating to woods labour policy. The Committee was composed of members from

various departmental agencies dealing with manpower and production. Representatives of the industry, chiefly managers or secretaries of the various woods associations, were invited to attend the meetings and, owing to their close contact with the industry, were of great assistance.

As a result of close co-operation with the Department of National Defence material assistance was afforded to the industry by members of the armed forces, particularly army personnel, who were granted special leave. In the autumn of 1943 arrangements were made under which army personnel stationed in Canada, who had previous woods experience in British Columbia, could obtain up to 6 months renewable leave to return to woods employment in that province. This was restricted to British Columbia because of the importance of year-round lumber production as well as the production of Sitka spruce for aircraft manufacture.

Late in 1943 arrangements were made with the Department of National Defence and the British Ministry of Supply to return some 1,900 members of the Canadian Forestry Corps to Canada, where it was felt they could be employed to advantage on operations supplying forest products to Great Britain. Those wishing to do so were given special leave to engage in woods work, some returned overseas with other units, while others remained in the Forestry Corps and were subsequently employed chiefly on fuel-wood and other such operations directly under the Department of National Defence.

Visits were made during 1945 by National Selective Service officers to military depots, particularly in British Columbia and Quebec, as part of an educational campaign to describe opportunities in woods employment to army personnel who would later be returning to civilian life.

As demobilization increased some special training facilities were set up for veterans and others to teach power-saw and other logging methods in British Columbia and general mechanized logging in Ontario. On-the-job training in logging practices, including the care and use of tools, is being expanded, particularly in Eastern Canada. Instructional staffs in most cases are frequently being given supervisory training in co-operation with the Canadian Vocational Training Branch of the Department of Labour.

Besides regular woodsmen, other rural workers, and military personnel on leave, a number of special groups were employed on woods operations, including German prisoners of war, who were first used in logging in 1943. Their services did not prove too satisfactory at first, particularly in lumbering in Quebec. During the summer of 1944, however, the use of prisoners in Ontario was greatly expanded and by 1945 there were nearly 7,500 employed in that province alone, with about another 1,500 in the rest of Canada. On the whole they performed the work well and made a valuable contribution to the industry.

A much smaller special group consisted of Canadian Japanese who were moved from Pacific Coast areas early in the war. They were used especially in the interior of British Columbia and in Alberta.

In 1943 provision was made for the use of conscientious objectors on forestry operations. As in the case of the Japanese, only comparatively small numbers were available, but important aid was given by this group in some localities.

General Observations

Although the first signs of a woods labour shortage appeared in the fall of 1941, both employment in logging and production of forest products increased during each of the first two war years. By the summer of 1942 the continued movement of men away from rural areas into the armed forces and into war industries, resulted in serious shortages of labour both for woods and other rural employment. A falling off in the production of forest products during late 1942 and the first half of 1943 reflected these shortages.

With the woods labour program, including the publicity and educational campaign, more fully developed, an increase in the numbers employed on woods operations occurred in the autumn of 1943. When the season's peak was reached in January, 1944, employment was considerably above the 1942-43 level. Continued woods labour campaigns and other factors contributed to a steady increase in the woods labour supply each succeeding year as is indicated in the following table:—

YEARLY EMPLOYMENT INDICES IN LOGGING

(Based on 1926=100)

Year	Index	Year	Index
1926.....	100	1936.....	138.7
1927.....	109.3	1937.....	139.3
1928.....	114.5	1938.....	142.8
1929.....	125.8	1939.....	119.1
1930.....	108.0	1940.....	166.9
1931.....	60.1	1941.....	137.8
1932.....	42.6	1942.....	106.5
1933.....	66.5	1943.....	180.4
1934.....	124.7	1944.....	215.8
1935.....	126.9	1945.....	247.3

Although employment increased and vacancies reported by employers correspondingly fell off from 1943 to 1945, there still remained a large net labour demand in woods operations. This fact is brought out in National Employment Service data shown in the next table:—

NET LABOUR DEMAND*, WOODS INDUSTRIES, 1943-46

Month	1943	1944	1945	1946
January.....	33,400	19,600	23,100	
February.....	21,400	14,700	13,500	
March.....	14,700	9,700	8,500	
April.....	15,300	12,800	10,800	
May.....	17,300	9,500	11,400	
June.....	18,500	7,900	15,000	
July.....	19,200	13,100		
August.....	17,400	11,200		
September.....	27,100	27,400		
October.....	38,000	38,300	34,400	
November.....	57,000	31,100	25,500	
December.....	44,440	26,900	23,700	

*"Net Labour Demand" is defined here to include total unfilled orders registered by employers at Local Employment offices, less unconfirmed allocations.

The post-war release of men from industry and the armed forces was not accompanied by their proportionate return to the farms and forests. This was not entirely unexpected as it was realized that once having enjoyed the amenities of urban living many workers would be reluctant to return to the comparative isolation of farms and woods camps.

Shortages of woods labour during the war years encouraged the extension of mechanization, more year-round logging operations east of the Rocky Mountains and an improvement in living and working conditions. Wage increases were allowed in the industry under wartime wage control regulations. This, plus the fact that more work was done on a piece-work basis of remuneration, permitted earnings of woods workers to compare favourably with wages in other industries.

While there is a trend, as noted above, towards year-round logging operations in the central and eastern provinces, the industry will no doubt depend for some time on the reciprocal flow of labour between agriculture and forestry. Typical seasonal changes in woods employment east of the Rocky Mountains during 1945 are illustrated below:-

WORKERS EMPLOYED ON PULPWOOD OPERATIONS EAST OF THE ROCKIES,
BI-WEEKLY DURING 1945*

Date	Workers Employed	Date	Workers Employed
January 13.....	48,856	July 14.....	16,542
January 27.....	54,351	July 28.....	14,168
February 10.....	50,815	August 11.....	13,970
February 24.....	45,454	August 25.....	15,626
March 10.....	38,281	September 8.....	19,351
March 24.....	24,303	September 22.....	25,117
April 7.....	16,331	October 6.....	32,693
April 21.....	25,746	October 20.....	40,509
May 5.....	24,059	November 3.....	45,507
May 19.....	20,248	November 17.....	54,270
June 2.....	18,024	December 1.....	57,710
June 16.....	17,302	December 15.....	57,846
June 30.....	17,539	December 29.....	42,514

*From data supplied by member companies of the Industry Pulpwood Committee of the Pulp and Paper Industry.

Finally, it may be said that the pressing demands of war and the resulting necessity of utilizing available manpower to the best advantage have been instrumental in bringing the various branches of the industry and Dominion and provincial government agencies into close co-operation. There is every indication that this co-operation will be maintained and that it will work to the mutual advantage of all concerned during the post-war period.

CHAPTER V

The Canadian Forestry Corps, 1940-1945*

The Canadian Forestry Corps originated in the war of 1914-18 as a non-combatant specialist corps of the Canadian Army, with battalions recruited chiefly from infantry units in the field. Its organization in the war of 1939-45 consisted of companies forming a specialized corps whose functions included that of defence in the event of invasion. For this purpose each company was fully equipped with small arms, and received a minimum of two months' basic military training before leaving Canada.

With the outbreak of hostilities in 1939, it was realized that greatly increased timber production in the United Kingdom was essential to the successful prosecution of the war. Heavy losses in the "Battle of the Atlantic", made it imperative that a minimum of shipping be utilized for the transportation of raw material. It was suggested that specialized labour be brought overseas to log the forests of the United Kingdom and France. The Canadian Government was requested to organize 20 forestry companies, ten of which would operate in France and ten in the United Kingdom.

By June, 1940, an agreement was reached whereby the Dominion Government assumed responsibility for pay, pensions, and cost of transportation of Forestry Corps personnel to and from Great Britain, while the expenses connected with technical equipment and maintenance were borne by the Government of the United Kingdom. It was decided to form twenty companies for operations in the United Kingdom, the fall of France having precluded their use on the Continent.

Formation of Corps

Command of the Corps was given to Brig.-Gen. J. B. White, C.B.E., D.S.O., E.D., a practical lumberman with long military experience, who had commanded the Canadian Forestry Corps in the war of 1914-18. Second-in-Command was Col. G. M. Strong, D.S.O., who held this post until June, 1942, when he was replaced by Col. C. E. F. Jones. Colonel Jones assumed command of the Corps in the autumn of 1943.

Recruiting for the twenty companies was begun without delay, and a basic training program instituted by each company as its recruiting was completed. In October, 1940, an advance party of six officers and 52 other ranks sailed for the United Kingdom. At Christmas the Corps Headquarters and one company (No. 5 from northwestern Ontario) arrived in Scotland. Headquarters were located at Blair Atholl, Perth, where No. 5 Company set up the first mill just outside the village. Woods operations were begun immediately, and material for bunk houses, workshops, and warehouses was sawn in the Scotch type of mill, pending the arrival of Canadian equipment. By the middle of July, 1941, the twenty companies had arrived in Scotland, and were operating in the north and northeast in the neighbourhood of Inverness and on Deeside.

Headquarters of the Canadian Forestry Corps was responsible for five district headquarters, twenty companies, and one reinforcement section. Corps Headquarters staff was made up of three divisions: operations (technical), training, and administrative. Four technical sections also were authorized, namely, auditing and accounting, transport, technical equipment and supplies, and forestry. Canadian medical personnel (R.C.A.M.C.) were attached to both corps and district headquarters.

The company establishment provided for a complement of 194 all ranks, commanded by a major, with a captain, an adjutant, and three subalterns in charge respectively of woods operations, the mill, and technical matters. Companies were grouped territorially under the command of Officers Commanding Forestry Districts. At first each district contained five companies, with a headquarters staff of five officers and thirty other ranks, but the excessive distance at which the companies had to operate made it expedient to revise the establishment to include four companies and a district headquarters of four officers and twenty other ranks.

Timber Operations

The allocation of timber blocks was arranged by the Assistant Forestry Commissioner for Scotland under the direction of the Home Grown Timber Production Department, Ministry of Supply. These blocks were located entirely on private estates, as the public forests consisted for the most part of immature stands planted subsequent to 1919. The timber to be cut was practically pure Scots pine with a small percentage of European larch and Norway spruce. Douglas fir and birch were also found in small quantities.

Logging methods employed were those of the most up-to-date lumbering firms in Eastern Canada. A few companies of British Columbia loggers used high-lead, sky-line or drag-line systems where the rugged nature of the area warranted. Tractors and rubber-tired sulkies were employed to haul logs from the woods, eliminating the use of horses. A log pond was dug at each mill and a jack-ladder employed between the pond and the log deck. Sawmills were of a semi-portable rotary type, with 16-foot carriage, three-saw edgers, and trimmer tables. Each mill was powered by a 100 h.p. Diesel engine. Logs were sawn into planks or larger sizes if possible, to be resawn later in civilian mills. Slabs were resawn on the Scotch benches mentioned previously, producing short lengths of one inch and one-half inch lumber. Production figures showed an average of 25,000 ft. b.m. of sawn lumber per mill for each working day.

*Information for this chapter was obtained from official sources, by permission of the Department of National Defence.

In addition to lumber many other products were cut to help augment the national stock. These included special logs, poles and piling, posts and pickets, round mining timber, railway ties, lagging, quartered props, pulpwood and birch spoolwood. Some slabwood was sold for firewood to communities adjacent to mill sites, but zoning transportation restrictions prevented its use at any great distance from the mills.

Military Training

The Corps placed considerable emphasis on its combatant nature, as contrasted with the Corps of 1914-18. In addition to the two months' basic training received before leaving Canada, regular military training was carried on under the general direction of a Military Training and A.R.P. Officer attached to Corps Headquarters. Each company was equipped with a full complement of rifles, 10 Thompson sub-machine guns, 3 Bren light machine guns, 1 Sten machine carbine and 1 Boys anti-tank rifle. Training included drill, musketry, anti-gas procedure, range practice, etc. One day each week, usually Saturday, was allotted for this training, and officers and N.C.O.'s were detailed to attend instructional courses under arrangement with C.M.H.Q. and Scottish Command.

By agreement, the units of the Canadian Forestry Corps were given the following duties, in the event of an invasion:—

- (a) To protect their own camps.
- (b) To attack air-borne troops should they land in an area in which the C.F.C. was operating.
- (c) To co-operate with the Home Guard and Imperial troops that might be in the vicinity.
- (d) To man road blocks within reasonable distance from the different C.F.C. camps.
- (e) To defend neighbouring aerodromes and flying fields within the C.F.C. operational area.

Various companies participated in exercises in conjunction with the Home Guard and regular troops under Scottish Command. Selected details from companies of No. 2 District also assisted at a Royal Inspection at Balmoral Castle on September 7, 1941, where they were reviewed by H.M. the King.

Expansion of the Corps

In July, 1941 (at the same time as the last units of the first twenty companies arrived in Scotland), a further request was made by the Secretary of State for the Dominions for additional companies. It was agreed in January, 1942, to recruit and send overseas an additional ten companies. These companies arrived in Scotland during the second week of October, 1942, and were absorbed into the existing five Forestry Districts. The strength of the thirty companies now totalled 6,359 all ranks.

Return of Companies to Canada.

Within five months of the arrival overseas of the increased establishment, proposals were being put forward to reduce the strength of the Canadian Forestry Corps. To assist in the building up of reinforcements for the Canadian Expeditionary Force, a policy had already been adopted of freeing high-category men for combatant service. At the same time five companies were earmarked for service with the B.E.F. Discussions followed for several months during which time arguments were advanced in favour of returning to Canada all units not required by the Expeditionary Forces. It was stated that the same amount of effort would produce a greater output if the companies were employed in the larger stands of timber in Canada. This would alleviate the heavy drain on British forest resources, and at the same time relieve the fuel-wood shortage in Canada by the utilization of residual wood.

Canadian Military Headquarters were instructed in September, 1943, to arrange for the return to Canada of 2,000 Canadian Forestry personnel, comprising one district headquarters and five companies. Accordingly, in the following month a total of 48 officers and 1,905 other ranks were struck off strength in order to return to Canada.

Operations in Canada

The critical fuel-wood situation in Canada during the War was alleviated to a considerable extent by the use of C.F.C. reinforcement troops who had not been sent overseas. At the request of the Wood Fuel Division of Timber Control, they were employed in cutting fuel-wood and in loading wood for rail shipment. More than 22,000 cords of fuel-wood were cut, and an additional 22,000 cords loaded on cars for shipment to other parts of Canada.

Special Projects

The value of the work done by the C.F.C. in the United Kingdom was not limited to its contribution to the national stock of lumber. Following the heavy snowfall of the winter of 1941, units of the Corps demonstrated their versatility by plowing the main roads in the North Highland area, using snowplows constructed in their own workshops. This proved of inestimable value both to the civilian population and to Scottish Command, for commercial travel and troop movements. This service was continued during the next two winters, the equipment being augmented by new snowplows from Canada.

Personnel of the C.F.C. also acted as firefighters in the 1942 season of high fire hazard. They built roads, constructed a prisoner-of-war camp to house 500 Italian prisoners near Blair Atholl, and cleared the site for the large R.C.A.F. aerodrome at Dunsfold.

Prior to the opening of the Second Front in Northwest Europe, the feasibility of rafting long piling and square timber across the Channel for the use of Allied Engineer units, was investigated by the War Office. This would release much-needed shipping for the transportation of munitions and other war supplies. The C.F.C. was requested to supply the men to build these rafts, and in March, 1944, detachments were sent to Southampton and to Barry (southwest of Cardiff on the Bristol Channel) for this purpose. The rafts varied in capacity from 70,000 to 90,000 ft. b.m., depending upon the sizes of timber used in their construction. Fifty rafts of square and 7 of round timber were constructed at Southampton, and 27 of square and 47 of round timber at Barry. The efficiency of the construction crews is evidenced by the fact that not a single stick was lost during towing operations, although heavy seas were encountered when rounding Land's End.

While the rafts were being built, crews were employed unloading lumber brought by ship and rail to Southampton. A special "V" trestling structure for loading locomotives and trucks on board ship at Dover was also constructed. It was during this operation that Canadian Forestry men came under shell fire for the first time, from German guns at Calais.

Formation of No. 1 Canadian Forestry Group

In the middle of October, 1943, official approval was given for the allocation of five Forestry companies to operate with '21' Army Group. The companies were selected so as to represent all sections of Canada (No. 15—New Brunswick and Nova Scotia; No. 16—Quebec; No. 28—Ontario; No. 5—western Ontario and eastern Manitoba; and No. 30—British Columbia). An intensive course of military training was begun at once to fit the men for their new role. Seven months later five additional companies were allocated to the Group, and these also ceased lumbering operations and began intensive military training. A Group Headquarters was formed under Col. C. E. F. Jones, with a staff of 15 officers and 110 other ranks. Two district headquarters, Type B, mobile, comprising 2 officers and 16 other ranks, completed the establishment. By the end of July, 1944, the entire Group was concentrated under '21' Army Group on the south coast of England.

Operations on the Continent

No. 1 Group Headquarters and No. 8 Forestry District landed in France during the first week of August, and commenced cutting operations in the Cerisy Forest, Normandy. At this time, No. 220 Pioneer Company (British) and Nos. 129 and 131 Companies R.E. (Forestry) were placed under the command of the Canadian Group. The mixed hardwood forest consisted almost entirely of beech and oak, with small areas of pure Scots pine. Cutting was done on a selective basis, as French forestry officials had urged that the residual stand should be not less than 300 trees per acre. Besides sawn lumber, the companies produced poles, pickets, pit-props, and piling for the reconstruction of harbour facilities at Cherbourg.

Towards the end of October the Group moved into Belgium where it was located in the Westerloo Forest, near Brussels. No. 16 Company was transferred to the Ardennes Forest, in the American sector, where it operated under the command of the United States 9th Army. It was soon joined by No. 7 Forestry District, and the six companies operated under a single control. Operations were for the most part in pure stands of Norway spruce, though some stands of beech and oak were encountered.

On December 16, when Field Marshal von Rundstedt broke through the Ardennes sector on a 40-mile front, the 7th Canadian Forestry District was forced to retreat, leaving behind twenty-one sawmills and other heavy equipment. After some delay, during which No. 1 Company was assigned the task of aiding an American combat engineer battalion to clear a wooded area in the vicinity of La Vacherie, the six companies withdrew to Brussels. Here they were assigned cutting blocks in the neighbourhoods of Brussels, Antwerp, Charleroi, Louvain and Lierre.

The work in Belgium included the cutting of saw timber, bridge timber, and material for the endless miles of corduroy roads in '21' Army Group line of communications area. In addition, the C.F.C. personnel were called upon to lift and transport pontoon bridging from the Orne to forward areas, and to design and supervise the construction of a boom across the Waal to protect the Nijmegen bridge from floating mines.

The first quarter of 1945 saw the forestry units employed in cutting square timber which was later resawn in civilian mills into lumber for prefabricated army huts. Corduroy logs, poles, pickets, and pitwood were also produced in large quantities. Heavy timbers and long piling were required for permanent bridges to be built later across the Meuse, and the Rhine and other large rivers in Germany. In the Ardennes Forest, to which units of the 7th Forestry District had returned, special sawmills had to be built in order to handle the 75-foot piling being cut for bridges over the Rhine. During this period, individual units of the C.F.C. were placed directly under the command of the First Canadian Army, and the 1st, 6th, and 30th British Corps.

Before the end of March, four companies had commenced operations on German soil and, following the end of the war in Europe, the entire Canadian Forestry Group was engaged in operations near Osnabrück, Minden, Bassum, Hanover, Hamburg, the Reichswald and the Rhine area.

In June, the first German Prisoner-of-War Forestry Company was formed and placed under command of Headquarters, Canadian Forestry Group. Other such companies were formed during the summer, and by autumn civilian timber operations were also organized. C.F.C. production gradually dwindled as units were repatriated to Canada, and by the last week of November, 1945, the Canadian Forestry Corps ceased to operate on the Continent.

Final Operations in Scotland

The agreement reached by the Dominion Government and the Ministry of Supply in 1943 was to the effect that the ten forestry companies remaining in Scotland should be disbanded as each completed its allotted timber site. Operations continued until the spring of 1945, when merchantable stands of timber were becoming practically exhausted.

A request was received in February, 1945, for the manufacture of fifty Scotch portable mills for use in Burma. This job was handled by the Construction and Maintenance Section which, by the end of March, had completed the first sample bench and was well on the way towards filling the contract.

In August, 1944, a refresher course in basic military training was instituted by the companies in Scotland. The course was of two weeks' duration, and provided an opportunity for each man to fire all infantry weapons. Two companies at a time were relieved from regular duties for this training.

As each company finished its timber operations, it was required to dismantle the mills, demolish all buildings, salvage lumber and building materials, and either fill in or fence the old mill ponds. By the end of June, 1945, all C.F.C. timber operations in Scotland were terminated. The first two companies were disbanded in March, and on the first of September, 1945, all companies and the C.F.C. Headquarters were officially disbanded.

Production Figures

The following table shows the total production of all units under C.F.C. control. Here the term "Other Units" refers to the 129th and 131st Forestry Companies, R.E., and No. 1 Spanish Pioneer Company. "Other Products" include special logs, poles and piling, corduroy logs, pickets and posts, round mining timber, railway ties, lagging, quartered props, pulpwood, and birch spoolwood.

TOTAL PRODUCTION—ALL UNITS UNDER C.F.C. CONTROL, 1941 to 1945

	SAWN LUMBER		OTHER PRODUCTS		SLABS	
	C.F.C.	Other Units	C.F.C.	Other Units	C.F.C.	Other Units
	M ft. b.m.	M ft. b.m.	M Cu. Ft.	M Cu. Ft.	Tons	Tons
Scotland.....	394,467		10,558		273,173	
France.....	6,239	1,151	82	30	18,609	1,197
Belgium.....	21,734	2,405	2,318	831	4,800	1,266
Holland.....	227		837	72	80	
Germany.....	19,840	1,362	1,029	104	7,723	449
Total.....	442,507	4,918	14,824	1,037	304,385	2,912

It will be seen that over $447\frac{1}{2}$ million board feet of lumber were sawn, in addition to the many other products manufactured. The total volume of sawn and otherwise manufactured products was 53 million cubic feet, and total output of slabs was 307 thousand tons.

Conclusion

The Canadian Forestry Corps contributed to a large extent to the saving of 12 million tons of shipping for other essential war materials. Its combined role of producing materials where they were most needed by the field forces, and of providing a defensive force which could be called upon in an emergency, assured the Corps an honourable place in the annals of the Canadian Army.

CHAPTER VI

Effects of the War on Forestry

The extraordinary demand for forest products arising from the war resulted in an increase in the average volume of fellings of about 451,700 M cu. ft., or 22 per cent over the pre-war figures. With the exception of the disastrous fire season of 1941, the losses in volume caused by forest fires were relatively small during the war years. Serious outbreaks of certain injurious insects have occurred which caused damage for which no reliable estimate can yet be made. It seems probable, however, that the overall annual rate of depletion of the forest during the war years was somewhere between ten and fifteen per cent above normal. As this figure did not exceed 1·8 per cent of the volume of accessible merchantable timber, it seems unlikely that any serious deterioration of the forest estate as a whole could have taken place.

It has been stated previously that the annual drain could be replaced by an average annual increment, throughout the accessible productive forest area, of about 11 cubic feet per acre. The corresponding rate for the year of greatest depletion during the war was 14 cubic feet per acre, which is a comparatively low figure. The relatively poor distribution of the cut, however, to which attention was drawn in Chapter I, makes it probable that this latter figure may be too high for safety, until such time as the extension of permanent transportation facilities makes most of the forest easily accessible, and until better methods of forest management are introduced.

In certain localities very serious over-cutting undoubtedly occurred and this is particularly true in the Provinces of Nova Scotia and Saskatchewan. There it seems inevitable that current rates of operation will have to be reduced in order to give the forests a chance to recover. In Nova Scotia, however, there is little evidence to indicate that much permanent or long-term damage has been done, because natural reproduction and annual growth are very good. In Saskatchewan, coniferous reproduction establishes itself with difficulty, and recovery may be delayed on this account.

In Eastern Canada most of the finest large yellow birch trees were felled in the search for suitable veneer logs, and the situation was made much worse by severe damage to this species caused by a devastating outbreak of the bronze birch borer in the Maritime Provinces. On the west coast, the limited stands of Sitka spruce were heavily over-cut in order to provide the high quality material needed by the aircraft industry. On the whole, however, the war damage to Canada's forests was not great, and the Dominion was fortunate in escaping any direct damage due to military operations.

The tendency to confine logging to the most easily accessible forests, which was already characteristic in Canada, was intensified during the war years because it was essential in the national interest to obtain the highest possible output per man-day from the shrinking labour force. As a war measure this practice was justified, but it undoubtedly had the effect of decreasing the value, if not the volume, of the forest estate, because future supplies will have to come from greater distances and at higher costs. In certain areas, and notably on the west coast of British Columbia, the wartime rise in prices of logs had the effect of increasing the economic accessibility of many stands which could not previously be cut without incurring financial loss. As a result, upward adjustments of log prices, especially for Western hemlock, were authorized from time to time. Generally speaking, however, price controls were rigidly enforced.

From the forestry point of view, the shortage of labour during the war years was not without its compensations. It has been stated that production increased by more than one-fifth over that of the pre-war period; but the conditions of demand were such that, had labour and other facilities been available, the increase might easily have been 100 per cent or more.

In certain parts of the Dominion, and notably in the Province of Quebec, very substantial progress was made during the pre-war decade in the preparation of working plans for the control of operations on large timber holdings. This work, although it did not come to a standstill, was seriously impeded during the war by the absence on military service of large numbers of trained foresters. It has been estimated that the number of practising foresters in Canada when the war broke out was about 700, and that more than 200 enlisted. Others volunteered but were not accepted because their services in forestry were deemed essential to the national war effort. Still further drains on the operating personnel were made by the drafting of individuals with special qualifications to other duties, including the administration of wartime controls.

Fire protection organizations lost large numbers of experienced personnel to the services and to industry and, in the face of the prevailing labour shortage, it was extremely difficult to secure replacements with the necessary qualifications and experience. In spite of this, however, fire losses were relatively low during the war, except for the disastrous season of 1941.

The following table shows the forested areas burned and the volumes of merchantable timber destroyed before and during the war:—

FOREST FIRE LOSSES IN CANADA

Period	No. of Fires Reported	Forested Area Burned	Merchantable Timber Burned
		Thousands of Acres	Thousands of Cu. Ft.
Average, 1934-38.....	5,882	1,718	414,386
1939.....	5,613	792	115,581
1940.....	6,284	1,448	236,203
1941.....	5,951	3,329	779,979
1942.....	4,791	915	134,703
1943.....	3,370	272	40,488
1944.....	5,820	1,664	327,630
1945.....	4,761	451	145,455

The wartime fire losses, while far higher than they should have been, were relatively low when compared to previous Canadian experience. This result must be ascribed, in part, to favourable weather conditions, but it also reflects very great and successful efforts on the part of the protection staffs.

Forest Finance

The best indication of the relationship between revenues from and expenditures on the forests is given by the public accounts of the provincial authorities. Corresponding figures for revenues and expenditures of private owners are not available. The following table summarizes information compiled by the Royal Commission on Forestry of the Province of British Columbia, and published in the Commissioner's Report in 1946.

FOREST REVENUES AND EXPENDITURES, ALL PROVINCES

Fiscal Year	Revenue	Expenditure
	\$	\$
1933-38 (average).....	8,579,980	4,771,414
1938-39.....	13,628,865	6,825,256
1939-40.....	13,853,550	6,901,900
1940-41.....	16,201,366	6,897,603
1941-42.....	17,526,505	7,396,003
1942-43.....	17,858,544	7,611,043

CHAPTER VII

Effects of the War on Future Forest Policy

The precision of forest inventories in Canada is not yet sufficient to permit of a direct comparison of estimates of forest areas, timber volumes, and increment before and after the war. The national inventory is compiled, from information provided by the provinces and the Dominion, at five-year intervals and during each period forest surveys are extended into new areas and further developments in aerial photography bring further knowledge. As a matter of fact the latest compilation, made in 1945, shows marked increases over earlier estimates in spite of the abnormally heavy drain during the war.

PROBABLE PERMANENCY OF WARTIME DEVELOPMENTS

Throughout the greater part of Canada there was a tendency to intensify logging operations in the best and most easily accessible stands of timber because of the need for maximum output from a restricted labour force. In the coast region of British Columbia, however, higher prices made possible the logging of stands previously considered inaccessible. Here the main consideration in determining accessibility was not so much distance from centres of consumption as the matter of altitude. In this region it has been found that small companies depending entirely on motor trucks for transporting logs from the forest to tidewater are able to operate successfully in many localities which, because the available volumes are small or because the topography is rough, could not be economically exploited by larger operators who depend chiefly on railways for log transportation. This development was very rapid during the war and is likely to be continued. It will entail considerable revisions of pre-war estimates as to what is and is not commercially accessible.

In Eastern Canada the war gave but little direct stimulus to the utilization of low-grade and small-sized forest material, such as thinnings. Coniferous pulpwood was already being cut to small sizes (about 4" top diameter) before the war broke out and large quantities of small hardwoods were ordinarily used for fuel-wood. There was one special development, however, which, though it did not have much influence on utilization during the war, may prove to be the forerunner of developments of considerable importance in the post-war period. The tremendous demand for sulphate or kraft pulp has resulted in the construction of three new kraft pulp mills and in the reopening and re-equipping of an old newsprint mill for the manufacture of this class of pulp. It is expected that these mills will be able to use many species of wood which are ordinarily left in the forest in the course of normal pulpwood operations.

On the west coast the pre-war trend towards the utilization of smaller logs was continued, and at least one new mill equipped with log gang-saws of the Swedish type came into operation. Considerable interest was aroused by experimental salvage operations in which the debris left on the ground after an area had been logged by the heavy powered equipment ordinarily employed was recovered and rafted to a pulp mill. It is understood that a number of problems remain to be solved before such salvage operations can be considered economical, but the volume of wood recovered was large, and further developments in this direction are confidently expected in the near future.

USE OF NEW TIMBERS AND OTHER PRODUCTS

As a result of shortages developing in the course of the war, and the heavy demand made upon certain well-known species such as Douglas fir, Sitka spruce, yellow birch, etc., it was found necessary to widen the field of available timbers by permitting deviations from specifications for aircraft and for some other military uses. In the aircraft field high grades of plywood, which normally would be manufactured from yellow birch, were made from western white birch, and in other directions substitutions were permitted. It is very probable that as a result of the wartime substitutions and the resulting increased knowledge of the qualities of the substitute materials, they will continue to be used for many of the purposes for which, previous to the war, they had been considered either as entirely unsuitable or of merely secondary value. The use of sugar maple for the manufacture of stressed plywoods had not had any large application previous to the war, but as a result of its use in aircraft it has now become an accepted species for highly stressed components. Similarly the substitution of Douglas fir, Eastern spruce, and Western hemlock for Sitka spruce was shown to be practicable with minimum change in design, and it is probable that the use of these species will continue to be recognized as good practice in aircraft construction in the post-war period.

A shortage of wood tar (used as a plasticizer in the manufacture of rubber tires) developed at a critical time during the war period, and an investigation to determine the possibility of producing a pine tar of sufficiently good quality to replace the Stockholm tar and other wood tars of European origin generally used for this purpose proved conclusively that satisfactory pine and other wood tars could be prepared from Canadian sources. However, the introduction of synthetic rubber, following the cutting off of the supply of the natural product, made further work on this project unnecessary. The possibility that the reopening of trade in natural rubber will bring about an increased market for wood tars of this type must not be overlooked.

In the field of lamination the development of new glues and resin cements has permitted the manufacture of laminated beams of considerable size having characteristics such as resistance to moisture and to bacterial growth in the glue line. The new laminated type of construction

may be considered as equivalent, if not superior, to solid wooden construction. Probable reductions in construction costs resulting from the laminating of large beams should ensure a future for this method of preparing structural elements.

The development of waterproof plywood brought about by the invention of synthetic resin glues based on phenol and resorcinol permitted external use of this material. Considerable advances have been made in our knowledge of plywood as a structural element. The advantages to be obtained by the scientific use of plywood as a web component in box-beams and I-beams are of sufficient importance to the engineer to warrant a careful examination of the economies to be obtained by the use of beams designed with webs of this material. Present trends indicate that structures embodying beams with plywood webs will continue to be of great interest to those requiring minimum weight and adequate strength combined in one element.

The tremendous increase in the demands for plywood for domestic housing and for the foreign market has resulted in the examination of the veneering qualities of other softwoods than Douglas fir. Western hemlock has been veneered successfully, and plywood made from this species is a very acceptable addition to the available supplies of softwood plywoods. Cottonwood plywood was manufactured previous to the war, but its output had declined. The present demand has given impetus to the manufacture of not only cottonwood but other poplars as veneers for plywood. Red pine was veneered for use in the manufacture of moulded aircraft fuselages during the war. This veneer makes excellent plywood, and it is probable that both red pine and white pine plywood will be manufactured in commercial quantities in the immediate future.

Laminated bow-string trusses and three- and two-hinged arches are among the newer developments in wood structural materials of considerable interest to the engineer, as the greater uniformity in strength of laminated wooden structures permits closer design with considerable reduction in the overall cost of lumber. In many laminated structures, by taking advantage of known differences in stress distribution, it is possible to arrange the laminations so that in areas of low stress lower grades of lumber may be included, the better grades being employed in those areas where the maximum resistance to stress is required. By such selection of lumber of different qualities, marketing of the less desirable grades is stimulated and the overall return from lumber operations increased.

Utilization of waste liquors from pulp and paper operations has been one of the most important problems confronting the chemist, and much effort has been expended upon research. In recent years these efforts have been rewarded to some extent by the discovery of some uses for the various by-products of wood found in the liquors which previously have been discarded. Lignin recovered from the soda cooking process has been utilized by incorporation with kraft pulp to produce papers suitable for manufacture into a hardboard under the action of heat and pressure. This material has many characteristics which make it suitable for such uses as table tops, wall panels, etc.

Sulphite waste liquor has been utilized both as a medium for the growth of yeasts and as a source of alcohol. The fermentable wood-sugar content of the liquor provides the food for the plants and, by suitable control, either ethyl alcohol or a high protein yeast suitable for food may be produced. While the production of yeast appears to be firmly established as economically sound, the future economy of alcohol production will probably be dependent upon the price of alternative sugar sources such as molasses.

Importation of certain species of wood, used for special purposes, dwindled during the war, partly because of the diversion of such species to other applications, and partly because of increasing prices. Attempts were therefore made to find woods of Canadian origin which might prove satisfactory substitutes. For example, shuttles were generally manufactured from dogwood or pecan. As an alternative, shuttles from the wood of the sugar maple were tested. Maple has some of the characteristics of the species previously used but is generally a little lighter. Impregnation with a suitable resin, however, considerably improved the natural qualities, and it is expected that this species will largely replace imported woods for this application. Prior to the war, research had been initiated to find a suitable substitute for locust wood, used almost universally at that time for insulator top-pins for power and communication lines. It was found that hard maple, beech, and yellow birch had sufficient mechanical strength but lacked the durable qualities of locust. Impregnating the pins with preservatives, however, extended their life, and as a consequence large quantities of them are replacing the locust pins previously used. It is expected that this development will continue, thereby making Canada independent of outside sources of supply, and probably reducing costs.

NEW STRUCTURAL USES OF WOOD

The developments of wood utilization during the war years have been previously cited. The probability of the continuance of the practices evolved during the period is largely a matter of economics. It is realized that much of our immediate forest wealth has been dissipated, perhaps unavoidably, but none the less effectively, in maintaining the huge supplies of wood and wood products required by the war effort of Canada and her allies. It is, therefore, doubly important that new methods and economies in handling lumber developed during the war should be used to improve the future of lumber production and utilization in Canada.

Extensive employment of ring-connectors in timber structures for hangars and other military establishments has disseminated knowledge of their use in engineering design of timber frames. There is every indication that stresses in timber structures will be much more subject

to critical examination than in the past, when timber design was frequently a matter of using traditional strength factors and rules-of-thumb. Furthermore, the more careful grading of timbers suitable for structures will permit closer utilization and economy, which will in turn tend to reduce wasteful consumption of available supplies and will lay increasing emphasis upon the advisability of making more intensive stress analyses for design purposes, even in the smaller types of structures, such as domestic housing.

Future trends in building with timber indicate that stressed skin construction will be employed much more effectively than in the past. The manufacture of plywood with water-resistant and water-proof glues has given an impetus to this type of construction, and prefabrication of unit panels of many sizes is now under way in Canada. The panels, which may constitute either whole sides of houses or may be considerably smaller units, and may be designed to accommodate window and door openings, are shipped to the building sites and erected with the minimum of on-site labour. Finishing of the structure can be completed after the outer shell is erected, a consideration of some consequence where very low temperatures occur during the winter months. The use of such prefabricated units permits erection of buildings at those seasons of the year when normal building is either completely discontinued, or is at a very low ebb, and the shop construction of panels during the winter months provides work for men in the carpentry trades at a season when employment in building is not readily available in Canada.

The great stands of centuries-old 'tall timber' that once covered so large a part of Canada have for many years past provided a plentiful supply of large structural material. Accessible supplies of such timber have now been largely cut, and, while a certain quantity is still available, the stands are so located as to make the handling of the large logs a somewhat costly and difficult problem. Moreover, it is taken for granted that, once the natural stands of such timbers are exhausted, they will never be replaced, as it would not be economically practicable to wait the centuries necessary for their growth.

In these circumstances, there has been of late years increasing interest in the possibility of building up large structural members from smaller components glued under pressure. The initial efforts proved to be quite successful and laminated construction, consisting of small elements glued together with casein glue, became an accepted method of building up the larger beams and trusses in structures, provided their use was economically sound. The use of casein glue, however, precluded such construction for exterior work, not only because of the effects of moisture upon the glue, but also because the action of bacteria upon the proteinic casein itself was apt to cause degradation of the adhesive and eventual disruption of the joint. The experience gained during the past few years with adhesives having phenolic or resorcinol bases has indicated that permanent joints, unaffected by the action of moisture or bacteria, may be obtained by the use of these adhesives. In consequence, there is evidence to show that increased interest in this form of construction is being taken by engineers and designers, and there is little doubt that this interest will eventually be translated into an increasing use of this type of construction.

The use of solid beams or beams of laminated construction for very large spans is impractical and uneconomical. Trusses or arches are necessary where clear unobstructed areas must be covered. Timber trusses of considerable size are readily constructed with laminated chords made from smaller timbers suitably glued with water-proof or water-resistant adhesives. Trusses of the bow-string type are particularly suited to laminated construction since the curved compression flange can be bent to any desired circumference by the use of thin glued laminations. Three-hinged arches can be made in much the same manner by the use of a number of thin laminations suitably glued under nail or clamp pressure. Additional laminations not running the whole length of the arch but confined to that section of the haunch of the arch where the stresses are largely concentrated will bring about considerable economies of material. These types of structures will have a definite place in future structural developments in Canada. Indications of this trend are already evident and there is little doubt that, as the method becomes more fully known, its value will be better appreciated. The aesthetic qualities of the arch type of construction also lend themselves to decorative treatment for churches, auditoriums, and similar buildings, to much more advantage than do beams and trusses.

The use of plywood for the webs of box- or I-section beams is arousing considerable interest. A number of large bridge girders have been produced in the United States and have proved to be very economical of timber. The high shear values that may be used in designing beams with plywood webs permit a reduction in the thickness of the members below that necessary when solid timbers are used. This improves the weight-strength ratio of the structure, permitting corresponding reductions in the size of footings, bents, etc., with the lessening of the dead loads to be carried. While this type of construction has not been developed to any great extent in Canada, experimental work carried out at the Forest Products Laboratories of Canada indicates that it has many possible applications, and will no doubt be used with increasing frequency as the possibilities of the method are more fully explored and the present accumulated test data more completely analysed.

The necessity of making substitutions of more readily available species, to supplement the supply required in great volume during the war years, was responsible for the development of some species for plywood which previously had received little consideration. In aircraft construction the species generally favoured in Canada were yellow birch and Sitka spruce. The former was used for plywood, the latter for wing beams, while smaller quantities of ash, rock elm, and white oak were employed for such parts as longerons, engine bearing blocks, and tail skids. The shortage of prime yellow birch veneer logs for home consumption and export was relieved to some extent by the use of Western white birch and sugar maple for plywoods of aircraft quality,

and the replacing of Sitka spruce by other softwood species, including Douglas fir, Western hemlock, and Eastern spruce relieved the shortage of wing beam material. The use of yellow poplar was largely eliminated by the development of red pine veneer, of excellent strength and gluing properties and somewhat lower in weight than the yellow poplar. While it is not expected that the aircraft industry will continue to consume the large quantities of veneers and plywoods produced during the war, considerable amounts will still be required for the furniture trades and in moulded boats of various types now being produced in Canada. Moulded furniture built from glued and laminated veneers is now being made, and it is expected that development in this field will be very considerable in the immediate future.

Plywood has been used for a number of years in the box and barrel industry. In recent years the introduction of new techniques has resulted in the costs of production being so reduced that plywood containers are able to compete with the older and better known packages. It is probable that the production and consumption of plywood containers will increase as methods of manufacture improve.

A recent development arising from current shortages of hardwood flooring combines the use of softwood boards with hardwood veneers. The softwood boards are faced with hardwood veneers, using resin adhesives, and then tongued and grooved in the same manner as standard flooring. The hardwood veneers have proved very resistant to wear and these floorings should be satisfactory for many years. The grain of the veneers is laid parallel to that of the board, which may be of sufficient thickness to permit its use without the necessity of installing a sub-floor in those rooms of a house where the loads are not too heavy. Plywood tiles have also been used very successfully for flooring. Recently, experimental floors have been made of a solid core of softwood faced with a plywood made from a hardwood-faced, three-ply construction, having softwood veneers for the core and opposite face. It is expected that the use of narrow strips of veneer for the floor boards will help to conserve much veneer now wasted in clipping. Softwood veneers faced with hardwood and glued to core stock also help to conserve hardwood veneer, and, being in large panels, reduce the time required to lay floors. Floors of this type can be laid successfully by gluing directly to the joists where level finished surfaces are prepared. Alternatively, the panels can be screwed to the joists in countersunk holes and hardwood plugs can be inserted to hide the screw heads. Floorings of the types mentioned have been subjected to heat and moisture cycles in a dry kiln over an extended period, and the results indicate that they can withstand considerable abuse without suffering any permanent harm.

EFFECTS ON SILVICULTURAL PRACTICE

With the exception of the more complete utilization of all tree species found in the forest which may result from the expansion of the kraft section of the pulp and paper industry, it does not seem likely that the relatively small changes in utilization practice that took place during the war will have any demonstrable effect on silvicultural practice. On the other hand, the war undoubtedly stimulated public interest in forestry to a remarkable degree. For the first time Canadian people experienced real, and in some cases severe, shortages of forest products required for their own use. Lumber became a scarce commodity so far as the civilian user was concerned. Supplies of paper, though sufficient, were no longer available in the variety to which users had been accustomed, and the fuel-wood situation at one time gave rise to considerable alarm. Discussion of the forestry situation in the public and trade press became widespread and the fact that wartime shortages continued into the post-war period makes certain that degree of public support which is essential if democratic governments are to introduce more advanced forest practices. Such improvements will undoubtedly include the introduction of more advanced silviculture.

Any attempts at intensive silviculture must necessarily be confined to the most accessible forests, and under conditions existing in Canada today, the logical place to start is the farm wood-lot. Here the owner is in constant touch with his woods and is able, at seasons of the year when other farm duties are least pressing, to give them reasonable attention. Programs intended to instruct the farmer in correct methods and to assist him in the profitable disposal of his forest products are being actively carried on by several of the provinces and special work in this field has been undertaken by the Dominion Forest Service.

In the more remote commercial forests it is not economically possible to undertake thinnings or other intermediate treatments during the development of the stands. Here the immediate problem is that of developing economical methods which will ensure reasonably prompt natural regeneration of the most desirable species. This may entail considerable modifications of present logging methods, and it is along these lines that substantial progress must be made in the years immediately ahead.

CHAPTER VIII

Wartime Lessons and Their Future Application

THE WARTIME ROLE OF THE FORESTRY PROFESSION AND FOREST SERVICES

Nearly 30 per cent of the membership of the forestry profession in Canada took a direct part in the war effort by enlistment in the armed forces. Many of these men were assigned to duties in which their specialized training and knowledge were utilized to good advantage for military purposes. As would be expected, the profession supplied a considerable number of officers to the Canadian Forestry Corps, and a number of foresters who were experienced in the interpretation of aerial photographs were able to render particularly valuable services, both to the Army and the R.C.A.F. Several of the ablest members of the Canadian forestry profession lost their lives.

In Canada, many forest officers were taken from their normal duties for the duration of the war. They assisted in the administration of controls, directed the work of prisoners of war and alternative service workers in forestry areas, served in technical and advisory capacities in Crown companies, and performed many other duties of a varied character.

Although many members of the profession served in the forces, and others assumed special and often novel responsibilities, the foresters who continued in the performance of their regular duties made not the least important contribution to the national war effort. Problems of timber administration and fire protection were made doubly difficult by the pressing urgency for rapid dispatch of affairs on the one hand and shortages of assistance on the other. Foresters engaged by industrial companies were under constant pressure to increase output and to achieve greater efficiency in logging operations and the fine response they made is shown by the record.

The forest services of the various provinces co-operated with the Dominion authorities in every possible way, making a great deal of special information available to Timber Control and other organizations, and carrying on their normal functions of administering timber and protecting the forests from destruction by fires in the face of great difficulties.

The normal research programs of the Dominion Forest Service were heavily curtailed during the war, but production of timber from the Forest Experiment Stations was greatly increased. On these stations several large prisoner-of-war and internment camps were erected, with those in custody doing useful work in the forest. The Dominion Service also took an active part in the formulation, during wartime, of plans for the post-war rehabilitation of forests in all parts of the country.

The Forest Products Laboratories provided technical advice on the use of timber in all phases of the war effort, and undertook important work in the redesigning and improvement of containers, structures, and many necessary articles made of wood. Some of the more striking results achieved are outlined elsewhere in this report.

In brief, the forestry profession and the forest services demonstrated, during the war, their importance to the national economy and the versatility and competence of their individual members.

THE ROLE OF TRADE ORGANIZATIONS

The principal trade associations played a significant part during the war through the assistance and advice they were able to give to Timber Control and other government bodies. Among these were the Canadian Lumbermen's Association, the Canadian Pulp and Paper Association, the British Columbia Lumber and Shingle Manufacturers' Association, the British Columbia Loggers Associations, the Quebec Forest Industries Association, and many other manufacturing, wholesale, and retail trade organizations. The services of a number of highly competent association officials were made available to the Government, and these men, because of their intimate knowledge of the trade, were able to do a great deal to secure support of their association members for various policies it was found expedient to adopt; one such official held the appointment of Deputy Timber Controller for an extended period. Other officials who remained at their posts assumed special duties and gave great assistance to the administration in connection with such matters as rationing, the establishment of priorities for supplies and man-power, and related matters. The associations also formed a natural channel through which producers could draw the attention of the Government to apparent anomalies in regulations and to hindrances which wartime restrictions placed on production. In many instances they were able to suggest changes which worked to the benefit of all concerned. Special committees composed of members of trade associations were established for the purpose of estimating weekly labour requirements, allocating export quotas, and other essential duties which could be performed more expeditiously by the trade. A number of associations which customarily maintained statistics for the information of their own members readily made these available to Government agencies. At association meetings, Government officials were given every opportunity to address large numbers of the producer members at one time, thus making it possible to give personal explanations of the reasons behind certain Government policies. In this way many misunderstandings were cleared up and co-operation between the industries concerned and the Government was promoted.

Although the body concerned is not a trade association, it may be appropriate to mention here the good service given during the war by the Canadian Forestry Association. This organization, which is supported by public subscription, was untiring in its efforts to impress upon the public the vital importance of the forests and their products, and to publicize the urgent need for the greatest possible care in the prevention of forest fires.

RESERVES OF FOREST PRODUCTS

Taken as a whole, Canada is fortunate in that she still possesses adequate and varied reserves of standing timber. In a few localities overcutting has resulted in shortages, but these have not yet reached any very great significance. Reserves of manufactured forest products exist in the form of stocks in the yards of sawmills and wholesale and retail lumber dealers, and reserves of pulp and paper are found in the warehouses and store-rooms of the manufacturers.

Stocks fell to a relatively low point during the war and the very active demand both at home and abroad will make it difficult to restore them to normal volume while the post-war emergency period lasts. With the return of more normal times, however, it is expected that stocks will be built up with relatively little difficulty.

No attempts have been made to maintain stocks of forest products at any particular level, nor does such action appear likely to become necessary. Instead, the stocks which should be held are left to the judgment of the manufacturing industry and the dealers in foreign countries. Under conditions as they exist in Canada it seems very unlikely that any attempt to create national stocks will be made in the foreseeable future.

CORRECTION OF WARTIME DEFICIENCIES

From the point of view of the future national welfare, the most serious defect revealed by the war in connection with Canadian forest operations was the lack of well-established and permanent means of communication and transportation, which might have permitted access to many valuable forest stands now classed as inaccessible. As a direct result, logging operations were concentrated in those stands that were most easily reached, and severe local overcutting undoubtedly took place. It is hoped that a great deal will be done in the coming years to correct this situation.

In 1941, Canada was forced to confront one of the most dangerous forest fire situations experienced for many years with protective staffs much depleted by the demands of war. While much of the resulting destruction would undoubtedly have been inevitable in any circumstances, the situation did reveal certain weaknesses in the protection organizations. These are under careful study by the authorities concerned, and improved organization and training will undoubtedly result.

The third major deficiency developed with respect to outbreaks of insect pests. It is now believed that the forest insect survey, originally started about 10 years ago, is far from adequate, although it has been very valuable. The outbreak of the spruce budworm epidemic in Ontario, and its subsequent progress eastward into Quebec and the Maritime Provinces, has served to focus attention on the necessity for a more extensive forest insect survey each year and for great expansion of the existing facilities for studying and devising means of protection against injurious insects. Remedial action to meet this problem was taken by the Dominion Government in September, 1945, by the establishment of a Forest Insects Control Board.

The functions of this Board do not involve the taking over or replacement of any existing services—entomological or otherwise. Its purpose is:—

- (1) To devise an over-all plan of attack on forest insect problems in Canada with the immediate and most urgent effort directed at the control of the spruce budworm;
- (2) To arrange for each Department—Dominion or provincial—to budget for, and carry out its own share of responsibility in this field;
- (3) To arrange for additional funds for special phases of the work when emergencies arise.

By this action the Board endeavours to co-ordinate the efforts of the various Dominion and provincial Governments into one integrated program, with a view to expediting the solution of the forest insect problem in Canada.

FOREST REHABILITATION

In 1941 the Prime Minister appointed a committee of prominent citizens to enquire into and report on problems which seemed likely to arise after the war was over. This body, known as the Advisory Committee on Reconstruction was under the chairmanship of Dr. Cyril James, Principal of McGill University. Among its sub-committees was one concerned with the conservation and development of natural resources, and a special report was prepared with respect to forestry. The main committee report, submitted in the latter part of 1943, recommended the transfer of further planning from non-official hands to the responsible agencies of government. From that time onward the formation of post-war plans rested with the Dominion and provincial authorities, and these plans have been discussed at a series of Dominion-Provincial Conferences.

From the point of view of forestry, the Advisory Committee on Reconstruction performed a very valuable function in that it provided a stimulus to all forest authorities to prepare concrete plans for the work that should be undertaken after the war. It also provided an opportunity to compare plans compiled in different parts of the country. The report of the sub-committee on conservation and development of natural resources, on which both government and the major forest industries were represented, will undoubtedly prove to be a document of major importance

in the development of forest policy in the Dominion. The basic thought running throughout the report is summed up in one paragraph which is quoted herewith:—

"From the standpoint of national wealth production and the maintenance of many communities, the development of permanent and prosperous forest industries is of the first importance. Forests are a renewable asset. Unfortunately, they are also destructible."

Starting from this point, recommendations were submitted for three sets of remedial measures described as preparatory, immediate post-war, and long-term.

The first group was mainly concerned with proposals for the introduction of Dominion legislation which, in the opinion of the Committee, was essential to the integrated development of forest policy in Canada. These proposals did not, however, in any way infringe upon the rights of the provinces to full autonomy in the administration of their own forests. Special attention was given to recommendations concerning the training of forestry staffs, both professional and sub-professional, and the provision of scholarships which would enable men to undertake specialized post-graduate work.

Among the immediate post-war measures advocated were the acceleration of demobilization from the armed forces of trained forestry personnel and the institution of apprenticeship schemes by forest industries. Emphasis was placed on the need for a comprehensive program of aerial photography throughout the Dominion, from which greatly improved inventories of forest resources could be developed. The calling of a national forestry congress to consider the whole forest situation throughout the Dominion was also recommended.

The long-term measures recommended included Dominion assistance to the provinces in forest protection until a point was reached where forest properties might be considered a commercially insurable risk. Selected forest industries should be provided with sufficient forest areas to ensure their permanence. Each province should maintain an accurate inventory of its forest resources, compiled on a regional basis and revised periodically to allow for growth and drain. Provision should be made for greatly expanded research in forestry and in the utilization of forest products, and greater assistance should be granted by governments to trade promotion work.

In 1945 a Dominion-Provincial Conference was called to consider all phases of relations between the Dominion and provincial governments. Detailed proposals were presented by the Dominion for consideration by the provinces, which, in turn, were invited to submit whatever proposals they considered appropriate. Included in the Dominion statement was a series of very important proposals with respect to forestry. These fully recognized that administration of forest resources within provincial boundaries was and should continue to be an exclusively provincial function. At the same time, it was suggested that Dominion assistance in the development of these resources was justified by the national interest in the welfare of the forest industries and in the important part their products play in the structure of Canada's foreign trade. It was proposed that Dominion activities in the fields of forest mapping and inventories, forestry and forest products research, and the development of permanent systems of forest communication and transportation should be greatly expanded.

No final decision has yet been reached with respect to these proposals, which are closely connected with such questions as the allocation of various taxes between Dominion and provincial authorities and with broad programs of social security and public expenditure. In the meantime, the Dominion is intensifying its forest protection and administration activities in the Northwest and Yukon Territories, and all the provinces are expanding their forestry work to a considerable degree.

In 1944, a Royal Commission on Forestry was established by the Province of British Columbia with Mr. Justice (now Chief Justice) Gordon Sloan sitting as sole Commissioner. Over a period of two years the Commission held a series of hearings and received representations from government, the forest industries, and the public. In his report the Commissioner presented a review of the whole forest situation in the Province which has been generally hailed as a model of thoroughness and clarity. A number of his recommendations were implemented by legislation at a session of the Provincial Legislature held shortly after the report was presented, and it is expected that many more will be similarly dealt with at the next session. One recommendation which the Government has stated it will not be able to accept is that administration of the forest resources of the Province should be placed in the hands of a more or less independent commission. The Premier of the Province states that it is the view of his Government that administration should continue to lie with the Department of Lands and Forests.

In 1945 the Province of Saskatchewan appointed a Royal Commission under the chairmanship of Frank Eliason, to conduct inquiries into forestry matters. Two interim reports have been published to date, recommending more adequate fire protection, and the curtailment of the annual cut on forest areas under Provincial control to an amount roughly approximating 1/20th of the estimated stand of merchantable spruce timber in each particular area. A new policy of timber disposal replaces the old practice of selling timber on a stumpage basis with a system of cutting and processing timber by contract. All timber for re-sale from Crown lands will remain the property of the people of the Province, and will be turned over at rail-head to the Saskatchewan Timber Board for marketing.

In 1946 the Province of Ontario appointed a Royal Commission under the chairmanship of Major-General Howard Kennedy, C.B.E., M.C., to investigate all phases of Ontario's forest

industries and to work out a comprehensive policy towards the economic development and perpetuation of the forest resources of the Province. The work of this Commission is still in progress at time of writing.

In the other five forest provinces, although formal public inquiry has not been considered necessary, forestry problems are receiving close attention from governments and from industry and steps are being taken to improve and strengthen administrative and protective services. These activities are in part a cause and in part a result of the greatly intensified public interest in forestry matters which has developed in Canada during the past decade and particularly during the war years. This interest is manifested in the financial and trade press, as well as in the daily newspapers and magazines, and there is growing evidence of a determination on the part of the public that the forests must be preserved as a source of wealth and a means of protection both for the present and for future generations.

RESEARCH AND EDUCATION

Research

Although a few small research projects had been carried out in earlier years, the commencement of forest research in Canada may be dated from 1917 when the first Forest Experiment Station was established by the Dominion Forest Service at Petawawa, Ontario. This forest, 100 square miles in area, provides a site for the establishment of long-term experiments and at the same time serves as a practical demonstration of the results which can be achieved through the application of sound principles of forest management. The earliest experimental work has now been in existence for nearly 30 years and is yielding results of great value. Four additional experiment stations have subsequently been acquired by the Forest Service in other major forest regions of Canada. Each station has a resident staff, and communication and transportation facilities have been provided with a view to obtaining the best possible protection against fire and ease of access for silvicultural and operational purposes.

The Forest Experiment Stations are centres for Dominion research work in their respective regions, but a great deal of additional research and investigation is performed on forest lands administered by the provinces and in some cases by the forest industries. Research activities on these stations embrace a wide field. Particular attention is given to investigations leading to the establishment of practicable silvicultural measures which can be applied to commercial operations under conditions existing in Canada. Special studies include harvest and intermediate cuttings, rate of growth, reproduction, tree breeding, seeding and planting, mensuration, forest working plans, and diversified logging operations.

On provincial lands and industrial holdings investigations having application on a Dominion-wide scale are carried out in co-operation with provincial governments to provide basic information on silvicultural cuttings, including regeneration after logging and fire, and rates of growth characteristic of different forest sites and types. The Forest Experiment Stations also provide regional centres for the conduct of special investigation and research on fire protection by the Dominion Forest Service. During the past 18 years great progress has been made in the elaboration of special techniques for short-term prediction of fire hazards. New methods developed have been adopted by the protection organizations of several provinces and have made possible more efficient use of protection staffs and reduction of such specific dangers as arise from the use of fire for clearing land. Field offices and small laboratories are also maintained at the Forest Experiment Stations by the Entomological and Pathological Services of the Department of Agriculture.

The Dominion Government is now actively engaged in a national program of air photography, the main purpose of which is the development of the natural resources. The forests have been given a prominent place in this program and a forestry requirement area of about 750,000 square miles has been laid out, to be covered in a 10-year period.

The object of this program from a forestry point of view is to classify and map the forests of Canada, using special techniques which have been developed. The carrying out of this work reduces the necessary field work to comparatively small proportions. As a result, the preparation of a complete forest inventory for Canada becomes a feasible proposition. An important aspect of the program is that the need for forest re-photography has been recognized. At the end of 10 years it is planned to photograph the same areas again in order to record the changes that have been caused by logging, fires, and other depleting agencies on the one hand, and by regeneration and growth on the other.

The Dominion Forest Service uses air photographs for forest survey purposes on federally administered lands and makes available to provincial governments information it compiles from photographs taken of provincial areas. The Air Surveys Division of the Service is conducting a research program along with the practical work, and a technique is being established that is facilitating the use of air photographs for forestry purposes. The most important advances are in relation to the volumetric estimating of the timber stands by means of fine measurements of the minute tree images as they appear in the air photographs.* Field data are being compiled which will form the link between the detail measured in the photographs and the estimates of timber quantities.

*For detailed information on aerial photographic interpretation see the following publications:

"Air Photographs as used by the Dominion Forest Service", by H. E. Seely, U.S. Journal of Forestry, October, 1938;

"Determination of Tree Heights from Shadows in Air Photographs", by H. E. Seely, Dominion Aerial Forest Survey Research Note No. 1, 1942;

"Air Photographs and Forest Sites" by S. T. B. Losee, *Forestry Chronicle*, September 1942 and December 1942.

A fertile field of investigation lies in the use of air photographs for the classification of forest sites. It has been found that the land form as viewed through the stereoscope is an important element in classifying sites. Topographic detail alone, however, is not enough; it must be complemented by geological data, site information as deduced from tree-growth, and a basic knowledge of local conditions and soils as determined by observations on the ground. Site classification by means of air photographs may well become of considerable importance in the preparation of working plans.

In addition to forest research work performed by the Dominion, several of the provinces maintain small research units of their own. Through consultation every effort is made to avoid duplication and to exchange research information between the different organizations.

A great deal of progress has been made in forest research during the past 30 years, but it is evident that the facilities available at the present time are not nearly adequate to meet the needs of the situation in Canada. Consequently, research staffs are being enlarged as suitable personnel become available and it is hoped that more money will be spent on this essential aspect of forestry work in the future.

Until recently all forest products research work in Canada was performed in the Forest Products Laboratories of the Dominion Forest Service. The first laboratory was established in Montreal in 1913, and transferred to Ottawa in 1927. A branch laboratory, intended to give special attention to problems peculiar to British Columbia, was opened in Vancouver in 1918. A pulp and paper research laboratory, originally operated in Montreal by the Dominion Government, has been reorganized under joint control of the Canadian Pulp and Paper Association, the Dominion Government, and McGill University under the name of the Pulp and Paper Research Institute.

It has been agreed that the facilities now available for research and the utilization of forest products are not adequate, and plans have been completed for the construction of a new laboratory in Ottawa. Additional accommodation is being provided for the Vancouver laboratory, and negotiations are now in progress for the reorganization of this establishment on a decentralized basis.

Education

Courses leading to degrees in forestry are offered by the University of New Brunswick, Laval University, the University of Toronto, and the University of British Columbia. At the outbreak of war there were between 600 and 700 graduates of these institutions employed in forestry work in the Dominion, about one-half of them being with the various governments and the rest with forest industry. The three forest schools in Eastern Canada have provided more or less standardized undergraduate courses with relatively little provision for specialization in individual branches of the science. In British Columbia alternative courses are available in which the emphasis is placed on engineering or commercial aspects of forestry, according to the choice of the student.

It is generally felt that the number of schools in the Dominion for training professional foresters is sufficient to meet present needs, notwithstanding the very large enrolments of veterans in the undergraduate courses. Whether or not provision should be made by Canadian universities for a higher degree of specialization by students who wish to devote themselves to some particular aspect of forestry is a matter on which no unanimity of opinion appears to have been reached as yet. On the whole, this development seems likely in the not distant future.

A forest ranger school, for the training of nonprofessional staffs for government and industry, has been operated successfully in the Province of Quebec for a decade. New schools have recently been established in New Brunswick (to serve all three of the Maritime Provinces), Ontario, Saskatchewan, and British Columbia, and enrolment of students has taxed these institutions to their full capacity. The establishment of ranger schools is most welcome to members of the forestry profession because it has long since become obvious that the man with professional training is greatly handicapped without the assistance of properly trained helpers. The ranger schools, therefore, should play a very important part in the development of sound forest management throughout the Dominion.

Education of the public, on whose interest and goodwill all progress in forestry ultimately depends, presents a problem in Canada which is most pressing and most difficult. Much excellent work has been done for many years by the Canadian Forestry Association, and from time to time very useful contributions have been made by the Dominion and provincial forest services. Although definite appropriations for educational work were sometimes limited, it does not mean that educational work was neglected. Much valuable work was accomplished through active co-operation with industry and the departments of education of the various provinces. The National Film Board and the Canadian Broadcasting Corporation lent their services particularly in the interest of forest fire prevention. During the war years forest products were of vital importance, and there was a constant flow of information in the press and on the radio on their use and value, and the need for protection of the forests.

The effect of this wartime educational work cannot but strengthen the growing realization that educational work, to be effective, must be continuous.

POSSIBLE CHANGES IN FOREST POLICY AND ADMINISTRATIVE ORGANIZATION

As has been previously mentioned, three provinces have established Royal Commissions to investigate the whole question of forest policy and administration and, up to the time of writing, only one of these has submitted its final report to the provincial government concerned. It is not possible, nor would it be proper, to attempt to forecast the findings of Commissions now sitting, but certain observations can be made respecting the situation in Canada as a whole.

In the first place, there is general agreement that all forest administrations must be strengthened, and action in this direction is in progress throughout the Dominion. In particular, it is recognized that adequate programs of investment in silviculture, and in better forest management generally, depend on the provision of more adequate protection against disastrous losses from forest fires, insects, and disease. Such improved protection, in turn, calls for extensive improvement programs to provide communication and transportation systems throughout the forests. Twenty years ago it was thought unwise to provide good roads in forest areas because of the attendant risk of travellers starting fires. To-day this attitude has been reversed because fires, set by hunters or trappers or by lightning, do occur in remote and relatively inaccessible areas and it is realized that rapid access to fires that do start is of the utmost importance. Legislation already exists in many provinces governing travel in the woods and, when the fire danger is known to be particularly acute, legal means exist for excluding the public from the forest.

Accurate knowledge of the forest estate can alone supply the basis for the development of adequate forest policies, and there is now great interest in the whole question of forest inventories and in the use of aerial photographic methods for their compilation. Technical methods for the interpreting of forestry data from aerial photographs have reached a relatively high stage of development in Canada and still greater progress in this direction is to be anticipated in the near future.

With respect to organization, the general tendency is in the direction of strengthening and expanding the organizations that now exist rather than toward creation of administrative agencies of an entirely new character. In certain provinces a considerable proportion of the revenues derived from the disposal of standing timber and from other forest resources has been used for public purposes entirely divorced from forestry. However, if the forests are to be maintained at a high level of productivity, it is essential that an increased amount of the revenue arising from them should be reinvested in the forests for their protection, development, and management.

In past years many sawmill operations were allowed to develop on a scale which tributary timber could not possibly support for more than a decade or two. At the present time new projects are carefully scrutinized and there is a tendency to restrict mill capacities to a point at which there is a reasonable chance for permanency of the operation and for the employment of labour.

In the same way, pulpwood licences were sometimes granted during the inter-war years without much regard for the general economic situation, the real possibilities for establishment of permanent and profitable markets, or even of the productive capacity of the forest areas involved. Here again a change appears to be in evidence and it is expected that new applications for permission to erect mills and for forest lands to provide them with raw material will be subject to careful scrutiny.

To sum up, it may be said that forestry in Canada is now in a state of transition from unregulated exploitation towards rational forest management. It is confidently expected that steady progress in the forest itself will in future keep pace with improved techniques in the manufacturing industries. Means for more complete utilization of the forest and of wood as a raw material are constantly being sought, and it is fully realized by the forest industries that these efforts can only be justified in the long run if the productivity of the forest soils is maintained.

